BS-120/BS-130/BS-180/BS-190
Chemistry Analyzer

Service Manual

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WARNING:

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NOTE:

This equipment is to be operated only by medical professionals trained and authorized by Mindray or Mindray-authorized distributors.

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- Freight policy: The customer is responsible for freight charges when this product is shipped to Mindray for service (this includes customs charges).
- Return address: Please send the part(s) or equipment to the address offered by Customer Service department.

Company Contact

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Foreword

Who Should Read This Manual

This manual is geared for service personnel authorized by Mindray.

What Can You Find in This Manual

This manual covers principles, installation procedures, theories, maintenance and troubleshooting guidelines of the BS-120/BS-130/BS-180/BS-190. Please service the system strictly as instructed by this manual.

Conventions Used in This Manual

This manual uses the following typographical conventions to clarify meanings in the text.

Bold and Italic font indicates text displayed on the screen, such as ***Sample Request***.

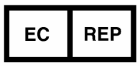
Safety Symbols

In this manual, the signal words ⚠ **BIOHAZARD**, ⚠**WARNING**, ⚠**CAUTION** and **NOTE** are used regarding safety and other important instructions. The signal words and their meanings are defined as follows. Please understand their meanings clearly before reading this manual.

When you see…		Then…
	WARNING	Read the statement following the symbol. The statement is alerting you to an operating hazard that can cause personal injury.
	BIOHAZARD	Read the statement following the symbol. The statement is alerting you to a potentially biohazardous condition.
	CAUTION	Read the statement following the symbol. The statement is alerting you to a possibility of system damage or unreliable results.
	NOTE	Read the statement following the symbol. The statement is alerting you to information that requires your attention.

Labels Used On the System

The labels attached to the panels of the system use symbols to clarify the meaning of the text. The chart below explains the symbols on the labels.

	Serial Number
	Date of Manufacture
	Manufacturer
	CE marking. The device is fully in conformity with the Council Directive Concerning In Vitro Diagnostic Medical Devices 98/79/EC.
	Authorized Representative in the European Community
	In Vitro diagnostic equipment
	Biohazard warning: Risk of potentially biohazardous infection
	Warning: Risk of personal injury or equipment damage
	Protective ground terminal
	Time limit in use for environmental protection (20 years)
	ON (Main Power)
	OFF (Main Power)
	ON (Power)
	OFF (Power)
	Serial communication port

Graphics

All graphics, including screens and printout, are for illustration purposes only and must not be used for any other purpose.

EC Representative

Name:	**Shanghai International Holding Corp. GmbH(Europe)**
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Safety Precautions

Observe the following safety precautions when using the Chemistry Analyzer. Ignoring any of these safety precautions may lead to personal injury or equipment damage.

WARNING

If the system is used in a manner not specified by Mindray, the protection provided by the system may be impaired.

Preventing Electric Shock

Please observe the following instructions to prevent electric shock.

WARNING

When the Main Power is on, users must not open the rear cover or side cover.

Spillage of reagent or sample on the analyzer may cause equipment failure and even electric shock. Do not place sample and reagent on the analyzer.

Preventing Personal Injury Caused by Moving Parts

Please observe the following instructions to prevent personal injury caused by moving parts.

WARNING

Do not touch the moving parts when system is in operation. The moving parts include sample probe, mixing bar, sample/reagent disk and reaction disk.

Do not put your finger or hand into any open part when the system is in operation.

Preventing Personal Injury Caused by Photometer Lamp

Please observe the following instructions to prevent personal injury caused by photometer lamp.

WARNING

Light sent by the photometer lamp may hurt your eyes. Do not stare into the lamp when the system is in operation.

If you want to replace the photometer lamp, first switch off the Main Power and then wait at least 15 minutes for the lamp to cool down before touching it. Do not touch the lamp before it cools down, or you may get burned.

Preventing Infection

Please observe the following instructions to protect against the biohazardous infection.

BIOHAZARD

Inappropriately handling samples, controls and calibrators may lead to biohazardous infection. Do not touch the sample, mixture or waste with your hands. Wear gloves and lab coat and, if necessary, goggles.

In case your skin contacts the sample, control or calibrator, follow standard laboratory safety procedure and consult a doctor.

Handling Reagents and Wash Solution

WARNING

Some reagents and wash solution may be corrosive to human skins. Plaase handle the reagents and concentrated wash solution carefully and avoid direct contact.In case your skin or clothes contact the reagents or wash solution, wash them off with water. In case the reagents or wash solution spill into your eyes, rinse them with much water and consult an oculist.

Treating Waste Liquids

Please observe the following instructions to prevent environmental pollution and personal injury caused by waste.

BIOHAZARD

Some substances in reagent, control, enhanced wash solution and waste are subject to regulations of contamination and disposal. Dispose of them in accordance with your local or national guidelines for biohazard waste disposal and consult the manufacturer or distributor of the reagents for details.

Wear gloves and lab coat and, if necessary, goggles.

Treating Waste Analyzer

Please observe the following instructions to dispose of the waste analyzer.

WARNING

Materials of the analyzer are subject to contamination regulations. Dispose of the waste analyzer in accordance with your local or national guidelines for waste disposal.

Preventing Fire or Explosion

Please observe the following instructions to prevent fire and explosion.

WARNING

Ethanol is flammable substance. Please exercise caution while using the ethanol.

Precautions on Use

To use the BS-120/BS-130/BS-180/BS-190 Chemistry Analyzer safely and efficiently, please pay much attention to the following operation notes.

Intended Use

WARNING

The BS-120/BS-130/BS-180/BS-190 is a fully-automated and computer-controlled chemistry analyzer designed for in vitro quantitative determination of clinical chemistries in serum, plasma, urine and CSF samples. Please consult Mindray first if you want to use the system for other purposes.

To draw a clinical conclusion, please also refer to the patient's clinical symptoms and other test results.

Operator

WARNING

The BS-120/BS-130/BS-180/BS-190 is to be operated only by clinical professionals, doctors or laboratory experimenters trained by Mindray or Mindray-authorized distributors.

Environment

CAUTION

Please install and operate the system in an environment specified by this manual. Installing and operating the system in other environment may lead to unreliable results and even equipment damage.

Preventing Interference by Electromagnetic Noise

CAUTION

Electromagnetic noise may interfere with operations of the system. Do not install devices generating excessive electromagnetic noise around the system. Do not use such devices as mobile phones or radio transmitters in the room housing the system. Do not use other CRT displays around the system.The electromagnetic noise might lead to system failures.

Do not use other medical instruments around the system that may generate electromagnetic noise to interfere with their operations.

Operating the System

CAUTION

Operate the system strictly as instructed by this manual. Inappropriate use of the system may lead to unreliable test results or even equipment damage or personal injury.

Before using the system for the first time, run the calibration program and QC program to make sure the system is in normal status.

Be sure to run the QC program every time you use the system, otherwise the result may be unreliable.

Do not open the covers of the sample/reagent disk cover when the system is in operation.

Do not open the reaction disk cover when system is in operation.

The RS-232 port on the analyzing unit is to be used for connection with the operation unit only. Do not use it for other connections. Only use the supplied cable for the connection.

The operation unit is a personal computer with the BS-120/BS-130/BS-180/BS-190 operating software installed. Installing other software or hardware on this computer may interfere with the system operation. Do not run other software when the system is working.

Computer virus may destroy the operating software or test data. Do not use this computer for other purposes or connect it to the Internet.

Do not touch the display, mouse or keyboard with wet hands or hands with chemicals.

Do not place the Main Power to ON again within 10 seconds since placing it to OFF; otherwise the system may enter protection status. If it does so, switch off the Main Power and switch it on again.

Service and Maintenance

CAUTION

Maintain the system strictly as instructed by this manual. Inappropriate maintenance may lead to unreliable results, or even equipment damage and personal injury.

Dust may accumulate on the system surface when the system is exposed to the outside for a long time.To wipe off dust from the system surface, use a soft, clean and wet (not too wet) cloth, soaked with mild soap solution if necessary, to clean the surface. Do not use such organic solvents as ethanol for cleaning. After cleaning, wipe the surface with dry cloth.

Switch off all the powers and unplug the power cord before cleaning. Take necessary measures to prevent water ingression into the system, otherwise it may lead to equipment damage or personal injury.

Replacement of such major parts as lamp, photometer, sample probe, mixer and syringe plunger assembly must be followed by a calibration.

Setting up the System

CAUTION

To define such parameters as sample volume, reagent volume and wavelength, follow the instructions in this manual and the package insert of the reagents.

Samples

CAUTION

Use samples that are completely free of insoluble substances like fibrin, or suspended matter; otherwise the probe may be blocked.Medicines, anticoagulants or preservative in samples may lead to unreliable results.

Medicines, anticoagulants or preservative in the samples may lead to unreliable results.

Hemolysis, icterus or lipemia in the samples may lead to unreliable test results, so a sample blank is recommended.

Store the samples properly. Improper storage may change the compositions of the samples and lead to unreliable results.

Sample volatilization may lead to unreliable results. Do not leave the sample open for a long period.

Some samples may not be analyzed on the BS-120/BS-130/BS-180/BS-190 based on parameters the reagents claim capable of testing. Consult the reagent manufacturer or distributor for details.

Certain samples need to be processed before being analyzed by the system. Consult the reagent manufacturer or distributor for details.

The system has specific requirements on the sample volume. Refer to this manual for details.

Load the sample to correct position on the sample disk before the analysis begins; otherwise you will not obtain correct results.

Reagents, Calibrators and Controls

CAUTION

Use appropriate reagents, calibrators and controls on the system.

Select appropriate reagents according to performance characteristic of the system. Consult the reagent suppliers, Mindray or Mindray-authorized distributor for details, if you are not sure about your reagent choice.

Store and use reagents, calibrators and controls strictly as instructed by the suppliers. Otherwise, you may not obtain reliable results or best performance of the system.

Improper storage of reagents, calibrators and controls may lead to unreliable results and bad performance of the system even in validity period.

Perform a calibration after changing reagents. Otherwise, you may not obtain reliable results.

Contamination caused by carryover among reagents may lead to unreliable test results. Consult the reagent manufacturer or distributor for details.

Backing up Data

NOTE

The system can automatically store data to the built-in hard disk of the PC. However, data loss is still possible due to mis-deletion or physical damage of the hard disk. Mindray recommends you to regularly back up the data to portable storage device.

Computer and Printer

NOTE

Refer to the operation manuals of computer and printer for details.

External Equipment

WARNING

External equipment connected to the system, such as PC and printer, shall be consistent with IEC 60950/EN 60950/ GB4943, EN55022 (Class B) /GB 9254 (Class B) and EN55024/ GB-T 17618.

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1 System Description

1.1 Overview

The BS-120/BS-130/BS-180/BS-190 is a fully-automated and computer-controlled chemistry analyzer designed for in vitro quantitative determination of clinical chemistries in serum, plasma, urine and CSF (Cerebrospinal fluid) samples. BS-120/BS-130/BS-180/BS-190 Chemistry Analyzer consists of the analyzing unit (analyzer), operation unit (personal computer), output unit (printer) and consumables.

1.2 System Components

BS-120/BS-130/BS-180/BS-190 Chemistry Analyzer realizes the ”two-disk + one-probe + one-mixing bar” scheme, which means one reaction disk, one sample/reagent disk, one sample probe and one mixing bar. Reaction disk is where cuvettes are placed; sample/reagent disk is where sample and reagent containers are placed; sample probe is used for dispensing R1/R2/S; mixing bar is used for mixing after S or R2 has been added. The photometric system adopts filter wheel photometer. The cuvettes are replaced manually after the tests are finished.

Figure1-1 Layout of the System Panel

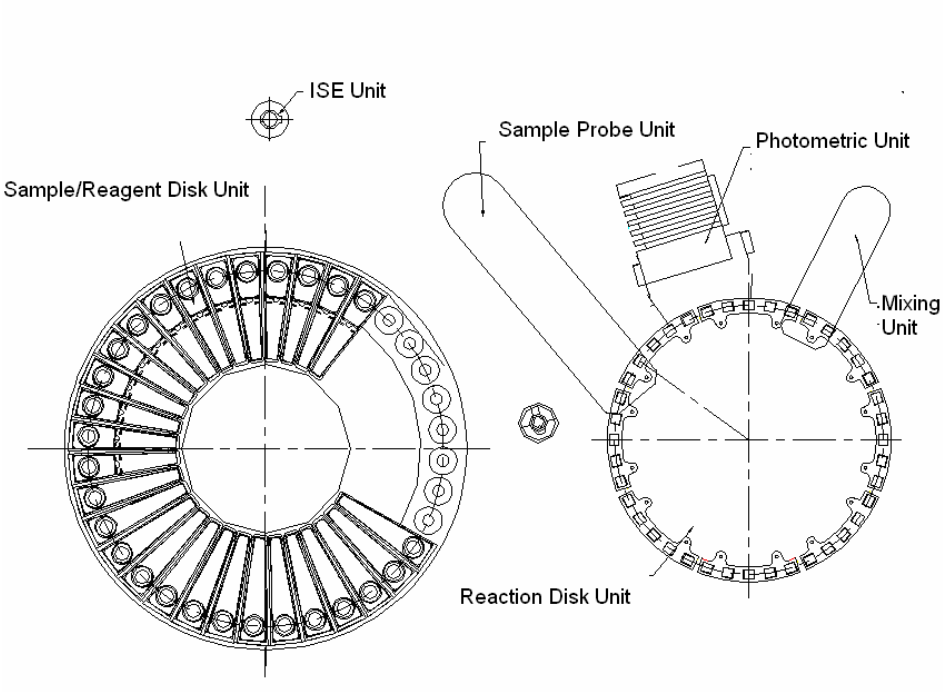


Figure 1-2 System Structure-Front View

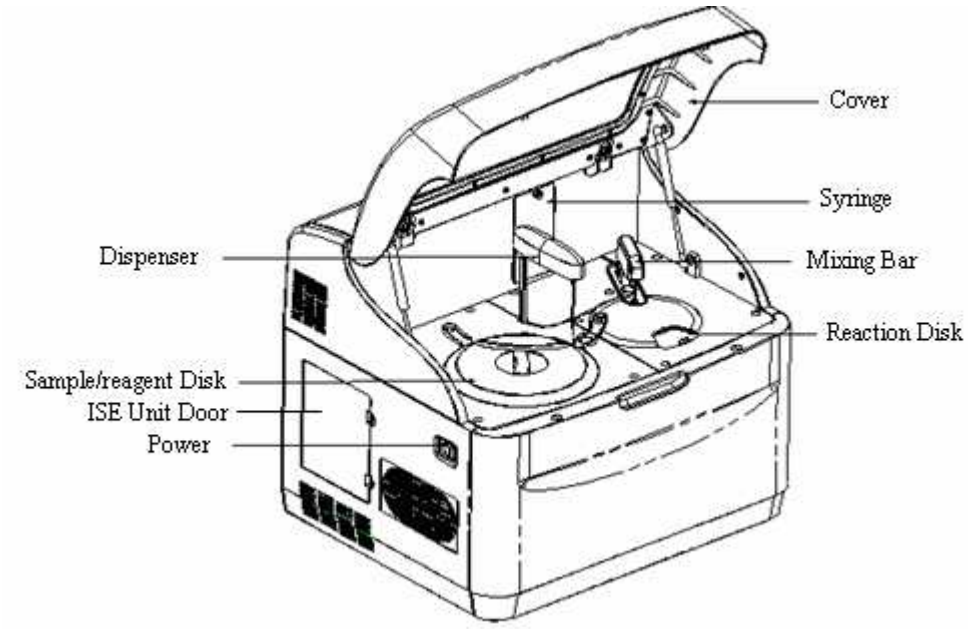
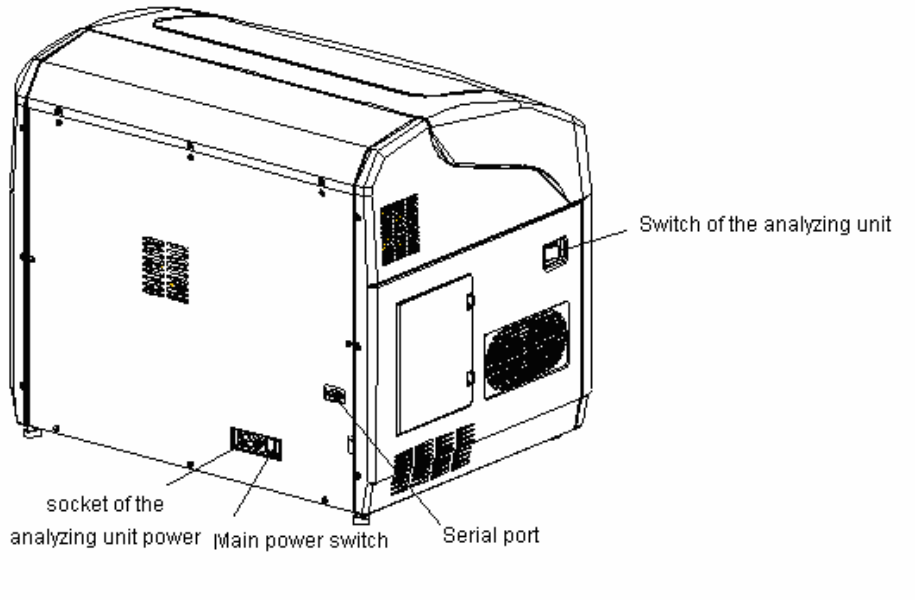


Figure 1-3 System Structure-left Panel View



1.3 Functions

The general working procedure of the BS-120/BS-130/BS-180/BS-190 is as follows:

1. All mechanical units are initialized.
2. The sample/reagent disk rotates to R1 aspirating position, and the probe aspirates reagent from a bottle on the sample/reagent disk.
3. The reaction disk carries the cuvettes to the sample/reagent dispensing position, and the probe dispenses reagent to a cuvette.
4. R1 is incubated in reaction cuvette for several periods.
5. The sample/reagent disk rotates to sample aspirating position, and the reaction disk carries the cuvettes to the sample/reagent dispensing position, then the probe dispenses the sample in the reaction cuvette.
6. With sample dispensed, the reaction cuvette rotates to mixing position for stirring.
7. In case of single-reagent tests, the reaction begins. When defined time is over, the reaction ends.
8. In case of double-reagent tests, when sample is dispensed and sirred, the sample/reagent disk rotates to the R2 aspirating position, and the probe aspirates reagent from the specified bottle on the reagent disk.
9. The reaction disk carries the cuvettes to the sample/reagent dispensing position, and the probe dispenses reagent to a cuvette.
10. With R2 dispensed, the reaction cuvette is carried to the mixing position for stirring.
11. During the first and second rotation of each period, the reaction cuvette receives photometric measurement.

12. When a batch of analysis is finished or all the cuvettes are used up, replace the cuvettes manually.

Table 1-1 Functions of System Units

UNIT NAME	**DESCRIPTION**
Sample probe unit	Aspirates and dispenses samples and reagents for all chemical and ISE tests.
Sample/Reagent Disk Unit	36 positions. Default: 1~8# sample position; 9~36# reagent position.
Reaction Disk Unit	Able to hold 40 cuvettes. It provides an environment in which sample reacts with reagents.
Mixing Unit	Used to stir the mixture in reaction cuvette when sample or R2 is dispensed.
Photometric Unit	Adopts filter wheel structure and performs photometric measurement (absorbance reading) at 8 wavelengths.
ISE Unit (optional)	ISE (Ion Selective Electrode) module (not installed on domestic product).

2 System Performace and Workflow

2.1 Technical Specifications

2.1.1 System Specifications

System

Random, multi-channel, multi-test

Sample type

Serum, urine, plasma and CSF (Cerebrospinal fluid)

Number of simultaneous measurements

13/26 single-/double-reagent tests

Throughput

BS-120/BS-130: 100 tests/hour, or 300 tests/hour with ISE unit.

BS-180/BS-190: 220 tests/hour, or 440 tests/hour with ISE unit.

Reaction types

Endpoint, Kinetic, Fixed-time; single-/double-reagent test; single-/double-wavelength test

Reaction time

Maximum 10 minutes for single-reagent analysis; maximum 5 minutes for double-reagent analysis.

Reaction liquid volume

BS-120/BS-130: 180-500μl

BS-180/BS-190: 150-500μl

Reaction temperature

37℃

Test scope

Clinical chemistries, immunoassays, TDM (Treatment Drug Monitoring)

Auto dilution

Dilution ratio 4~150; dilution is done in reaction cuvette.

Operation mode

System and tests are configured via the operating software. Profiles and calculation tests are allowed.

Calibration method

Linear (one-point, two-point and multi-point), Logit-Log 4p, Logit-Log 5p, Spline, Exponential, Polynomial and Parabola

Programming Controls

Westgard Multi-rule, Cumulative sum check, Twin plot

Data processing

Capable of storing and outputting various data and tables/graphs, and calculating among different tests

Dimensions

l×b×h:690 mm×570 mm×595 mm.

Weight

≤75kg

Emergent samples

Emergent samples can be inserted during test at any time.

Network connection

Able to be connected with LIS (Laboratory Information Management System)

2.1.2 Specifications for Sample System

Sample tube type

Microtube**:** Φ10×37mm, Φ12×37mm;

Blood collecting tube: Φ12×68.5mm, Φ12×99, Φ12.7×75, Φ12.7×100, Φ13×75, Φ13×100;

Plastic tube: Φ12×68.5mm, Φ12×99, Φ12.7×75, Φ12.7×100, Φ13×75, Φ13×100.

Minimum sample volume

Minimum sample volume=dead volume of the sample+total sample volume needed for all the tests

Dead volume of the sample: Microtube ≤300, Blood collecting tube≤500ul, Plastic tube≤500ul.

Sample position

Sample and reagent share one sample/reagent disk which is of single-circle structure. No.1-No.8 are sample positions which can be set as routine, QC, STAT positions.

STAT sample

Emergent samples can be inserted during test at any time and then run with high priority.

Sample volume

3μl-45μl, with increment of 0.5μl

Sample probe

Sample and reagent share one probe, which is capable of detecting liquid level, protecting the probe against collision in the vertical direction and tracking liquid level.

Sample probe washing

Inside and outside of the probe are washed with carryover less than 0.1%.

Sample input mode

Enter manually

When hand-held bar code system is installed, the sample information can be entered by using the bar code. Refer to the documents accompanying the optional hand-held bar code reader.

2.1.3 Specifications for Reagent System

Reagent refrigeration

24 hours non-stop refrigeration, refrigeration temperature: 4-15℃

Reagent dispensing

Reagent is aspirated and dispensed precisely by syringes.

Reagent types

1 to 2 reagent types, R1 and R2

Reagent volume

30μl-450μl, with increment of 1μl

Reagent position assignment

Sample and reagent share one sample/reagent disk which is of single-circle structure. No.9-No.36 are reagent positions and No. 35 is fixed for wash solution and No. 36 is fixed for dilution.Other positions can be assigned for R1 or R2. If ISE module is installed, No.34 is fixed for ISE wash solution.

Reagent input mode

Enter manually

When hand-held bar code system is installed, the reagent information can be entered using the bar code. Refer to the documents accompanying the optional hand-held bar code reader.

Reagent probe

Sample and reagent share one probe, which is capable of detecting liquid level, protecting the probe against collision in the vertical direction and tracking liquid level.

Reagent probe washing

Inside and outside of the probe are washed with carryover less than 0.1%.

2.1.4 Specifications of Reaction System

Optical path of reaction cuvette

5mm

Material of reaction cuvette

5mm×6mm×30mm, disposable reaction cuvette

Number of reaction cuvettes

40

Mixing method

One mixing bar, which starts to stir after adding a samples or R2

Photometric System

Filter wheel optical system

Wavelength

8 wavelengths：340nm、405nm、450nm、510nm、546nm、578nm、630nm、670nm

Wavelength accuracy

±2nm

Light source

12V, tungsten-halogen lamp, 20W

Photometric measurement method

Photodiode

Measurement range

0～3.5A（for 10mm optical path）

2.1.5 Specifications of Operation

Display

17/15” LCD and CRT, resolution: 1024×768, refresh rate: 70Hz

Operating System

Windows XP, Windows Vista

Communication interface

RS-232

Printer

Ink jet printer, laser printer (black-white) and stylus printer

Input device

Keyboard, hand-held barcode scanner connected to the network (optional)

Output device

Display, printer and LIS host

Storage device

Hard disk, USB port

2.1.6 Installation Requirements

Power requirement

100V-130V, 200V-240V

Power frequency

50/60Hz (±3Hz fluctuation)

Power of analyzing unit

350VA

Water consumption

Less than 2.5L/hour

Environment

Storage temperature: 0~40℃

Storage humidity: 30%RH-85%RH, without condensation

Above-sea-level height (storage): -400~5500 meters

Operating temperature: 15~30℃

Operating humidity: 35%RH-85%RH, without condensation

Above-sea-level height (operation): -400~2000 meters

2.1.7 Optional Modules

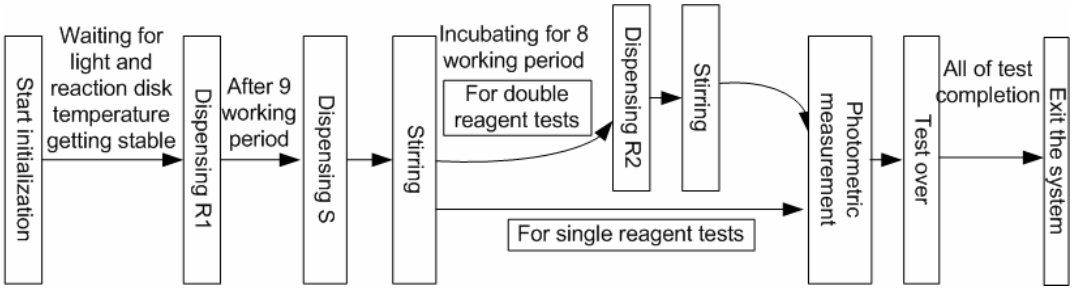
ISE (Ion Selective Electrode) module

Hand-held barcode reader

2.2 Workflow (BS-120/BS-130)

2.2.1 Overview

Figure 2-1 General Test Procedure of the BS-120/BS-130



2.2.2 Timing

2.2.2.1 Timing for Main Components

The working period of BS-120/BS-130 is 36 seconds, so its throughput is 100 tests/hour (3600/36). During each working period, the reaction disk rotates three times and stops three times. During each stop, the sample probe can dispense sample, first reagent and second reagent respectively. Therefore, the throughput is not affected no matter it is single-reagent test or double-reagent test because both of them have the same test efficiency. The practical throughput is affected by reaction time and cuvettes replacement.

The system collects photometric data two times during each period. Therefore, the interval between two absorbance readings is 18 seconds for each test.

The movements of major moving parts are shown in the following table.

Table 2-1 Timing of Major Moving Parts

Components	**Expected actions**					
Reaction disk	Stop	Rotating continuously to finish photometric measuring of all the cuvettes and stopping at the R1 dispensing position	Stop	Rotating continuously to finish photometric measuring of all the cuvettes and stopping at the R2 dispensing position	Stop	rotating and stopping after passing 9 cuvettes
Sample probe	Aspirating and dispensing S	Washing sample probe and aspirating R1	Dispensing R1	Washing sample probe and aspirating R2	Dispensing R2	Washing sample probe
Mixing bar	Mixing R2	Washing mixing bar	Mixing S	Washing mixing bar	Stop	Stop
Photometric system	Filter wheel rotating slowly, not performing photometric measurement	Filter wheel stops each filter on the measuring position in turn to finish photometric measuring	Filter wheel rotating slowly, not performing photometric measurement	Filter wheel stops each filter in the measuring position in turn to finish photometric measuring	Filter wheel rotating slowly, not performing photometric measurement	Filter wheel rotating slowly, not performing photometric measurement

2.2.2.2 Timing for Sample Probe

a. Lifting up from the wash pool

b. Rotating to the position above the sample/reagent disk

c. Lowering down to the sample tube

d. Aspirating sample and dispensing back a little

e. Lifting up from the sample tube

f. Rotating to the position above the reaction disk

g. Lowering down to the reaction cuvette

h. Dispensing the sample

i. Lifting up from the reaction cuvette

j. Rotating to the position above the wash pool

k. Lowering down to the wash pool

l. Washing inside and outside of the sample probe

2.2.2.3 Timing for Reagent Probe

The timing of dispensing R1 and R2 are basically the same, with slight difference in the reagent dispensed.Therefore, only the timing of dispensing R1 is shown in the following:

a. Lifting up from the wash pool

b. Rotating to the position above the sample/reagent disk

c. Lowering down to the reagent bottle

d. Aspirating R1

e. Lifting up from the reagent bottle

f. Rotating to the position above reaction disk

g. Lowering down to the reaction cuvette

h. Dispensing R1

i. Lifting up from the reaction cuvette

j. Rotating to the position above the wash pool

k. Lowering down to the wash pool

l. Washing inside and outside of the reagent probe

2.2.2.4 Timing for Mixing Bar

a. Lifting up from the wash pool and moving into the reaction cuvette

b. Sirring reaction liquid

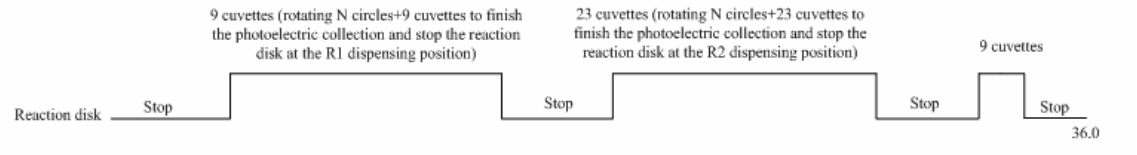
c. Lifting up from the reaction cuvette and moving into the wash pool

d. Washing mixing bar

2.2.2.5 Timing for Reaction Disk

The reaction disk can hold 40 reaction cuvettes. In each working period, the reaction disk rotates clockwise. It rotates and stops for 3 times respectively, and passes 41 cuvettes(9+23+9), which means the reaction disk finally stops at the next position clockwise.

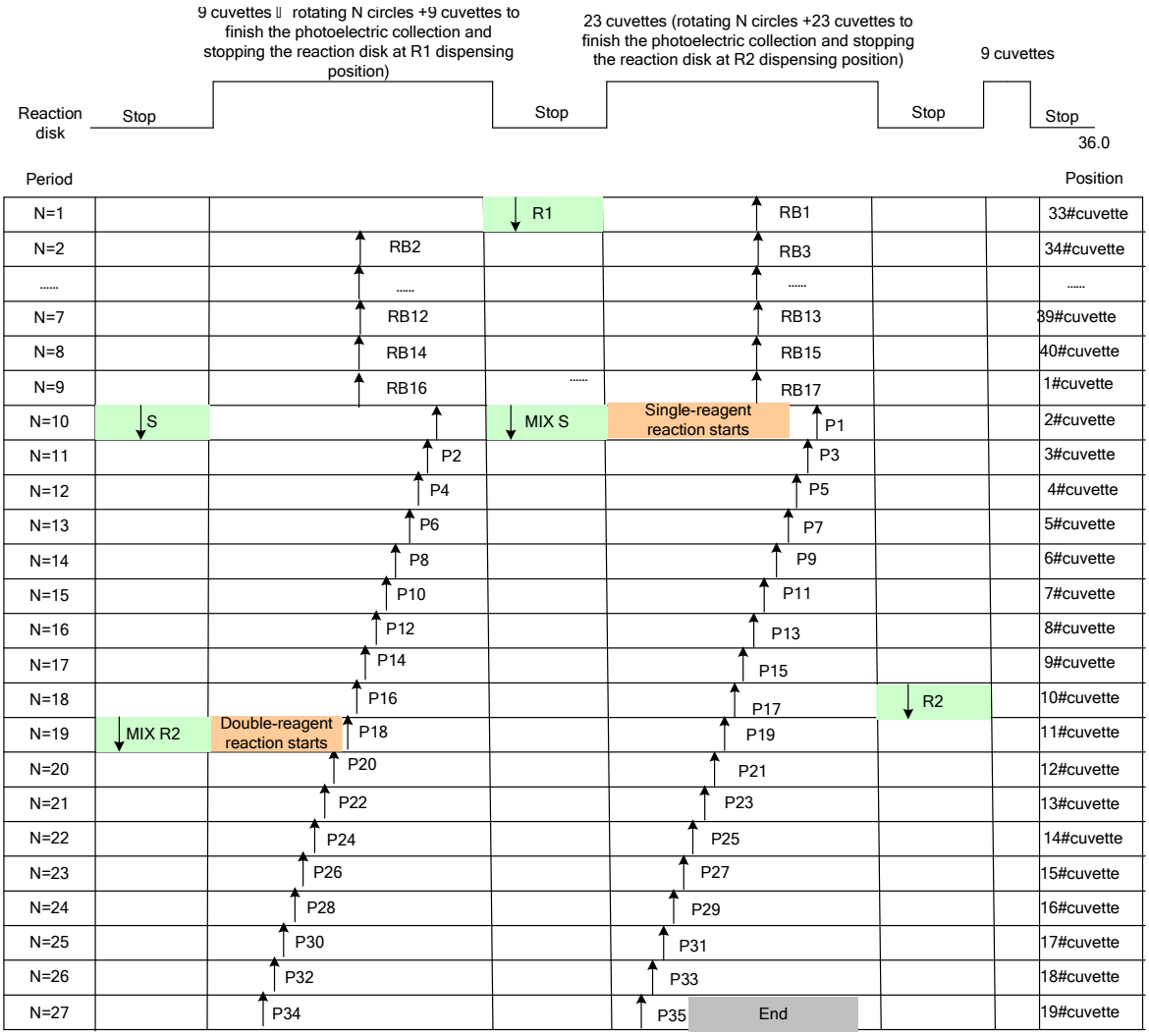
Figure 2-2 Timing of Reaction Disk



2.2.3 Test Workflow

A complete test work flow is show in the following figure.

Figure 2-3 Workflow for Single-/Double-reagent Tests



In the figure above, RB1-RB17 are the 17 reagent blank points measured after R1 is dispensed and before S is dispensed.P1-P35 are the 35 measuring points after sample is dispensed and mixed to the time when the test with the longest reaction time is finished.The measuring point, at which sample is dispensed but not mixed, is invalid and not used in calculation.

2.2.4 Measuring Points

Figure 2-4 Measuring Points for Single-reagent Tests

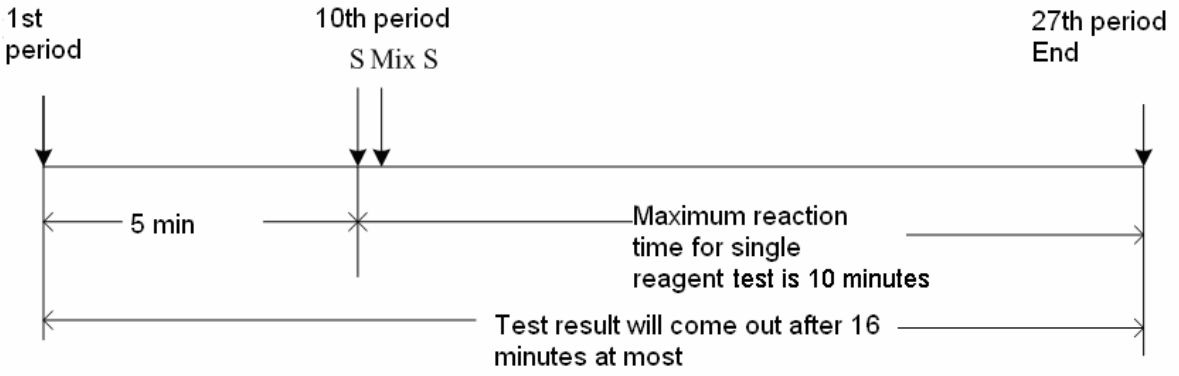
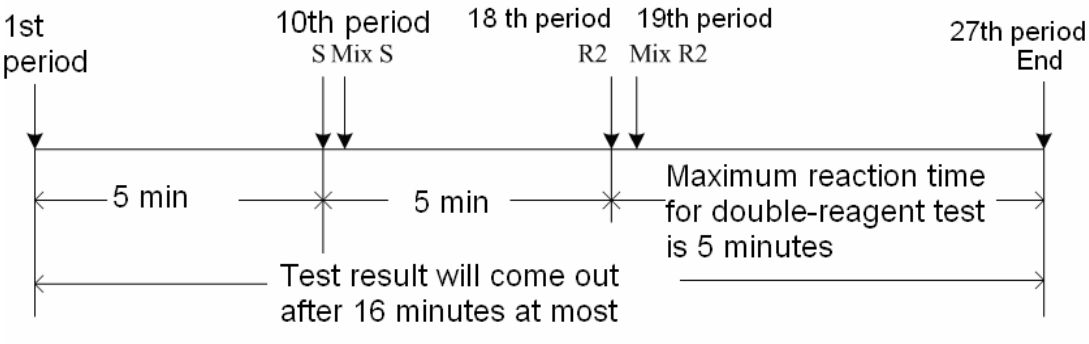


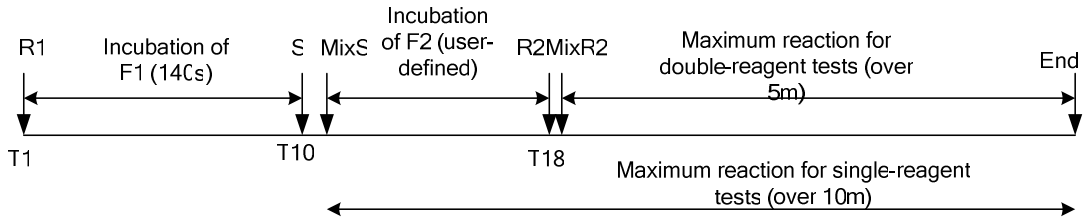
Figure 2-5 Measuring Points for Double-reagent Tests



2.3 Workflow (BS-180/BS-190)

2.3.1 Overview

Figure 2-6 General Test Procedure of the BS-180/BS-190



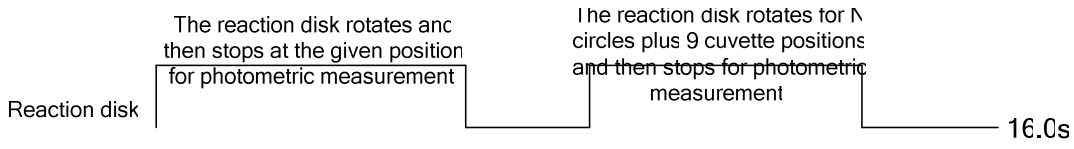
2.3.2 Timing

2.3.2.1 Timing for Main Components

The working period of BS-180/BS-190 is 16 seconds, so its throughput is 225 tests/hour (3600/16). During each working period, the reaction disk rotates two times and stops two times. During each stop, the sample probe dispenses R1 and sample and stirs the sample, and dispensing R2 is done in a single period. Therefore, the throughput is affected by single or double reagent tests. The practical throughput is affected by reaction time and cuvettes replacement.

The system collects photometric data two times during each period. Therefore, the interval between two absorbance readings is 16 seconds for each test.

The movements of major moving parts are shown in the following table.



Routine period (R1)	Wash probe and mixing bar	Aspirate S	Dispense S	Wash probe and mixing bar	Aspirate R1	Dispense R1/ Stir S
Non-routine period (R2)	Wash probe and mixing bar	Aspirate R2	Dispense R2	Wash probe and mixing bar		Stir R2

2.3.2.2 Timing for Sample Probe

a. Lifting up from the wash pool

b. Rotating to the position above the sample/reagent disk

c. Lowering down to the sample tube

d. Aspirating sample and dispensing back a little

e. Lifting up from the sample tube

f. Rotating to the position above the reaction disk

g. Lowering down to the reaction cuvette

h. Dispensing the sample

i. Lifting up from the reaction cuvette

j. Rotating to the position above the wash pool

k. Lowering down to the wash pool

l. Washing inside and outside of the sample probe

2.3.2.3 Timing for Reagent Probe

The timing of dispensing R1 and R2 are basically the same, with slight difference in the reagent dispensed.Therefore, only the timing of dispensing R1 is shown in the following:

a. Lifting up from the wash pool

b. Rotating to the position above the sample/reagent disk

c. Lowering down to the reagent bottle

d. Aspirating R1

e. Lifting up from the reagent bottle

f. Rotating to the position above reaction disk

g. Lowering down to the reaction cuvette

h. Dispensing R1

i. Lifting up from the reaction cuvette

j. Rotating to the position above the wash pool

k. Lowering down to the wash pool

l. Washing inside and outside of the reagent probe

2.3.2.4 Timing for Mixing Bar

a. Lifting up from the wash pool and moving into the reaction cuvette

b. Sirring reaction liquid

c. Lifting up from the reaction cuvette and moving into the wash pool

d. Washing mixing bar

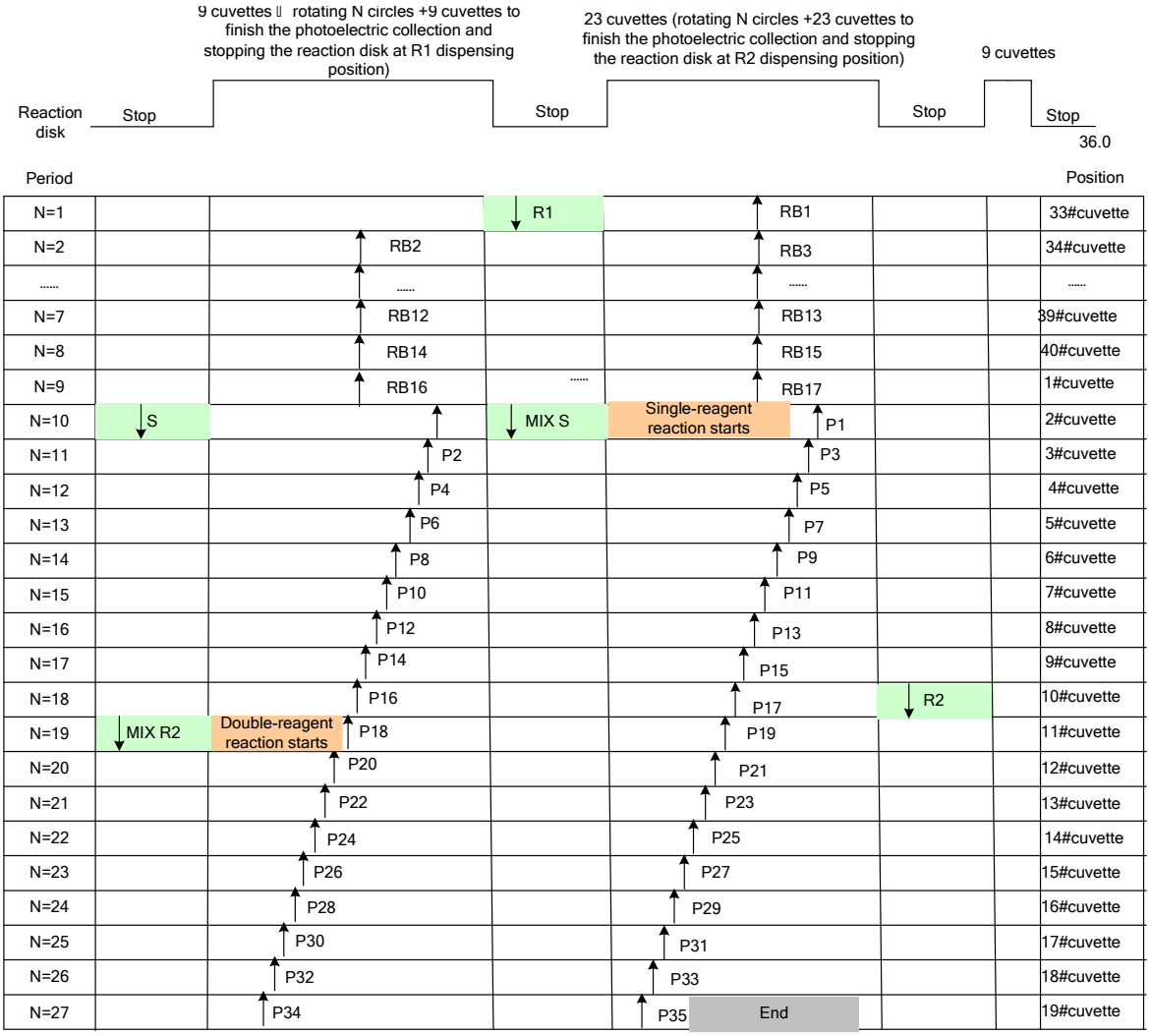
2.3.2.5 Timing for Reaction Disk

The reaction disk can hold 40 reaction cuvettes. In each working period, the reaction disk rotates clockwise. In a routine period, the reaction disk rotates and stops at the sample dispensing position, and then rotates for 9 cuvette positions and stops for stirring and R1 dispensing.

2.3.3 Test Workflow

A complete test work flow is show in the following figure.

Figure 2-7 Workflow for Single-/Double-reagent Tests



In the figure above, P1a and P1b are collected at different wavelengths in the same period.

3 Installation

3.1 Environmental Requirements

- The system is for indoor use only.
- The bearing platform should be leveled with gradient less than 1/200.
- The bearing platform should be able to bear 75Kg weight.
- The bearing platform should be 500mm-800mm high.
- The installation site should be well ventilated.

CAUTION

The system radiates heat when running. A well-ventilated environment helps keeping the room temperature stable. Use ventilation equipment if necessary. Do not expose the system to direct draft that may lead to unreliable results.

- The installation site should be free of dust as much as possible.
- The installation site should not be under the direct sun.
- The installation site should not be close to a heat or draft source.
- The installation site should be free of corrosive gas and flammable gas.
- The bearing platform should be free of vibration.
- The installation site should not be disturbed by large noise or power supply.
- The system should not be placed near brush-type motors and electrical contacts that are frequently powered on and off.

- Do not use devices such as mobile phones or radio transmitters near the system. Electromagnetic waves generated by those devices may interfere with operation of the system.
- The altitude height of the installation site should be lower than 2000 meters.
- Ambient temperature: 15℃-30℃, with fluctuation less than ±2℃/H.
- Relative humidity: 35%RH-85%RH, without condensation

CAUTION

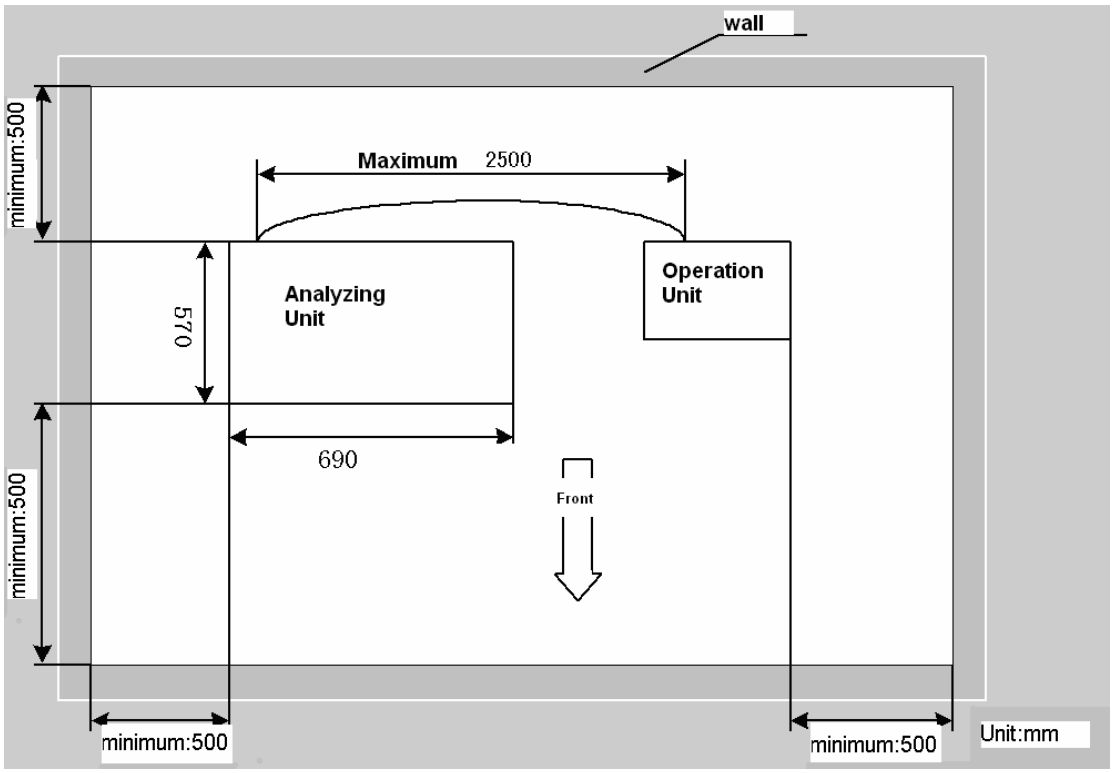
Operating the system in an environment other than the specified may lead to unreliable test results.

If the temperature or relative humidity does not meet the requirements mentioned above, be sure to use air-conditioning equipment.

3.2 Installation Requirements

3.2.1 Space and Accessibility Requirements

Figure 3-1 Space and Accessibility Requirements



3.2.2 Power Requirements

- Power supply: 100-130V/200-240V, 50/60Hz, three-wire power cord and properly grounded.
- The system should be connected to a properly grounded power socket.

- The distance between the power socket and the system should be less than 3 meters.

WARNING

Make sure the power socket is grounded correctly. Improper grounding may lead to electric shock and/or equipment damage.

Be sure to connect the system to a power socket that meets the requirements mentioned above and has a proper fuse installed.

3.2.3 Water Supply and Drainage Requirements

- The supplied water must meet requirements of the CAP Type II water, with specific resistance no less than 0.5(MΩ.cm@25℃).
- The water temperature should be within 5℃-32℃.

BIOHAZARD

Dispose of waste liquids according to your local regulations.

CAUTION

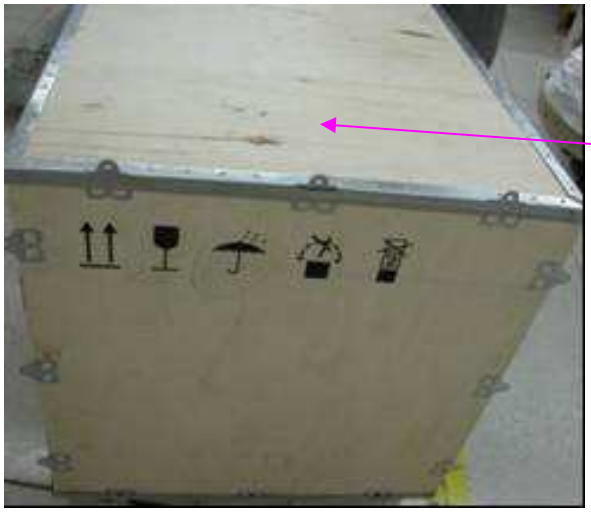
The supplied water must meet requirements of the CAP Type II water; otherwise insufficiently-purified water may result in misleading measurement.

3.3 Installation Procedures

3.3.1 Unpacking

- Check the delivery list before unpacking. Besides PC and printer box, there are three boxes for analyzing unit, accessory and deionized water tank, waste tank and used-cuvette bucket.
- The gross weight of the analyzing unit is about 95Kg. 3-4 people are needed to lay the wooden case containing the analyzing unit on the gound. Use fork truck, if possible.
- Use special tools to unpack the top cover and the side plate.

Figure 3-2 Unpack the Top Cover of the Wooden Case



Prize the fixing parts around the top cover, then remove the top cover.

Figure 3-3 Remove the side plate of the wooden case

Prize the fixing parts around the side plate, then remove all the side plates

Remove the plastic bag, and use the adjustable wrench to remove the four plates fixing the feet.

Figure 3-4 Remove the Fixing Plate

Remove the package plates of the front and back feet.

3.3.2 Installation

- Fix the analyzer: after the analyzer is placed on the target installation site, adjust the two front fixing bolts to ensure the four of them have the same height (the two behind are not adjustable).
- Remove the plastic cover and fixing bandage, and install the sample probe and mixing bar. Do not install the arm cover of the sample probe before calibrating the level detection board.
  - Place the ANALYZING UNIT POWER to ON while ensuring that the sample probe is not attaching any conducting .object, such as hands.
  - Calibrate the sample probe manually. Check if indicator D2 (yellow) is lightened within 2 seconds when the ANALYZING UNIT POWER to ON. Press the switch S2 on the level detection board and then release it, then check if indicator D2 is first extinguished and then lightened. If it is, that means the calibration succeeds.

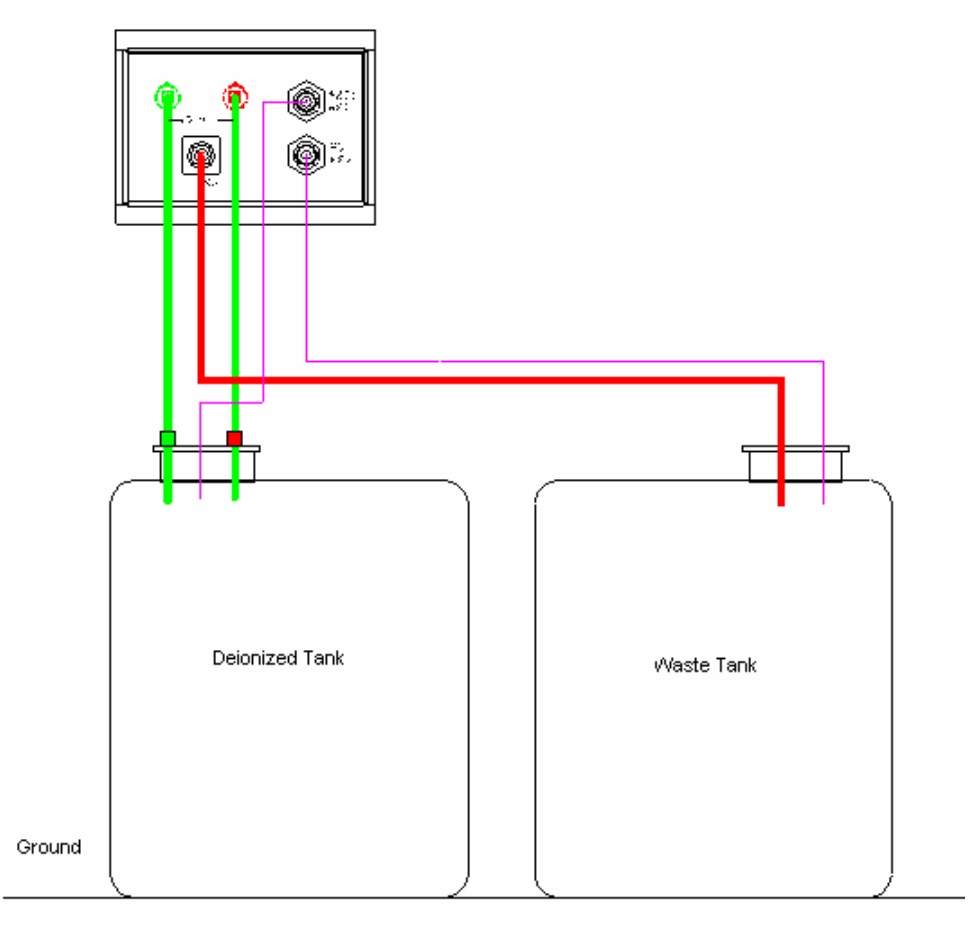
    Exercise caution to prevent the sample probe from attaching any conducting object during the calibration.
  - Place the ANALYZING UNIT POWER to OFF.

NOTE：

Remember to install the washer when installing the sample probe.

Use syringe to inject water into the filter and connect the filter to the cap assembly of the DI water tank. Connect the liquid tubes as indicated in the following figure.

Figure 3-5 the liquid tubes connecting



CAUTION

When placing the deionized water tank and waste tank, ensure the height difference between the top of the tank and the bottom of the upper cabinet is within 500-800mm.

Ensure the deionized water pickup tube and waste tank tube are not blocked, bent, or twisted.

- Install ISE module(optional)：Please refer to *4.8.3 Installing and Removing ISE Unit.*

CAUTION

When ISE module electrodes are installed, the power of ISE module should always be turned on. If the power has been turned off for more than 0.5 hour, please follow the instructions demonstrated in the section *7.7.4 Storage of ISE Module.*

3.3.3 Operating Software Installation

- **Installation preparation**

  Configuration:

  Operating System: Windows XP Home, Windows Vista Business.

  Memory: above 1G;

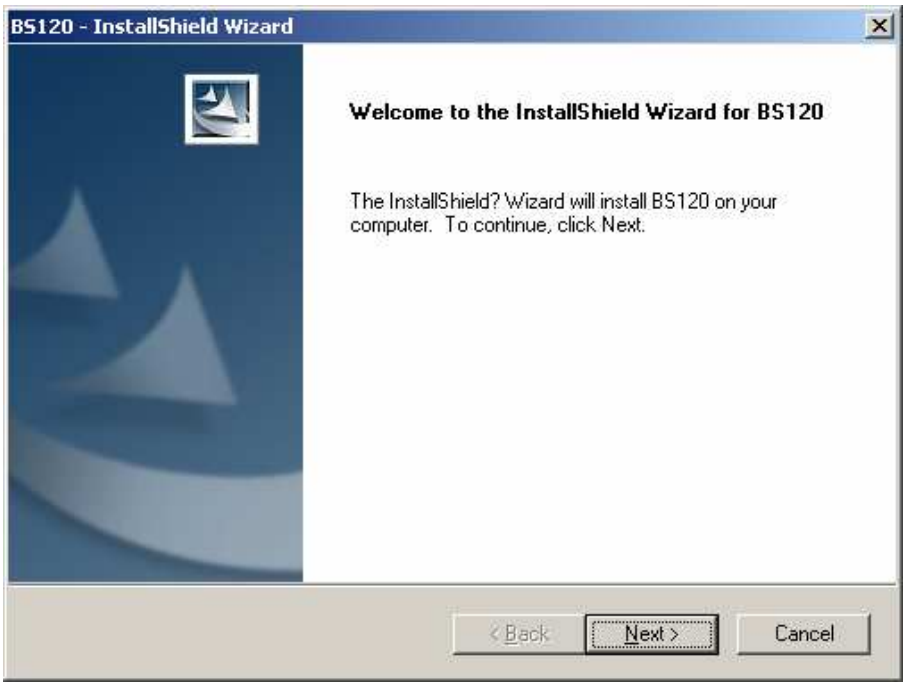
  Graphic Card: above 16 colors;

  Resolution: 1024*768

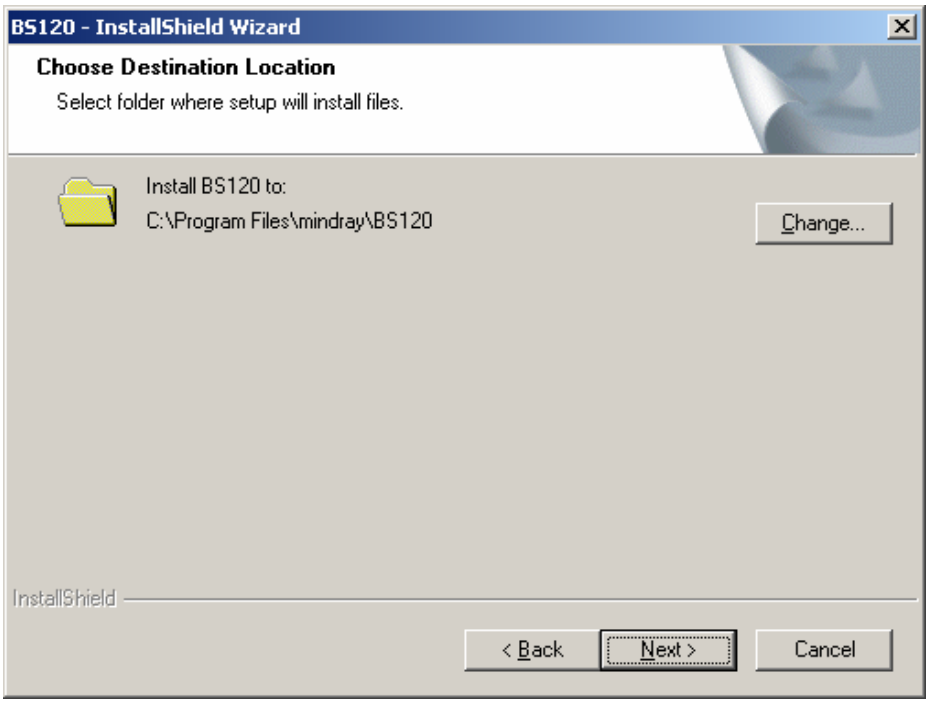
- **Installation procedure: (Take BS-120 as an example)**

  1）Double-click the Setup.exe file to start the installation. Select the installation language.

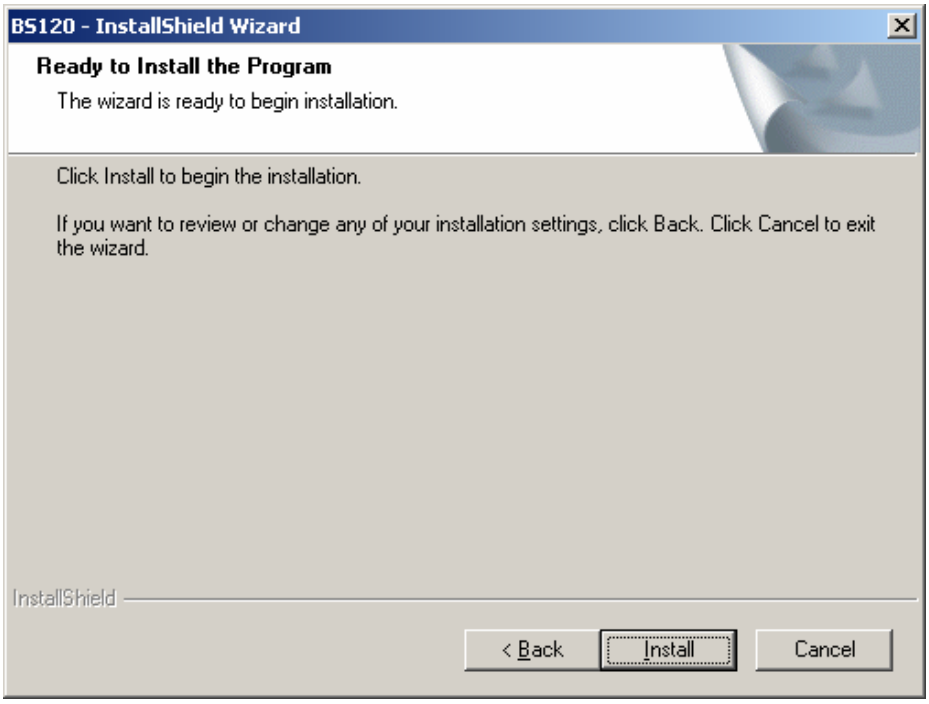
  2）Click ***Next***.



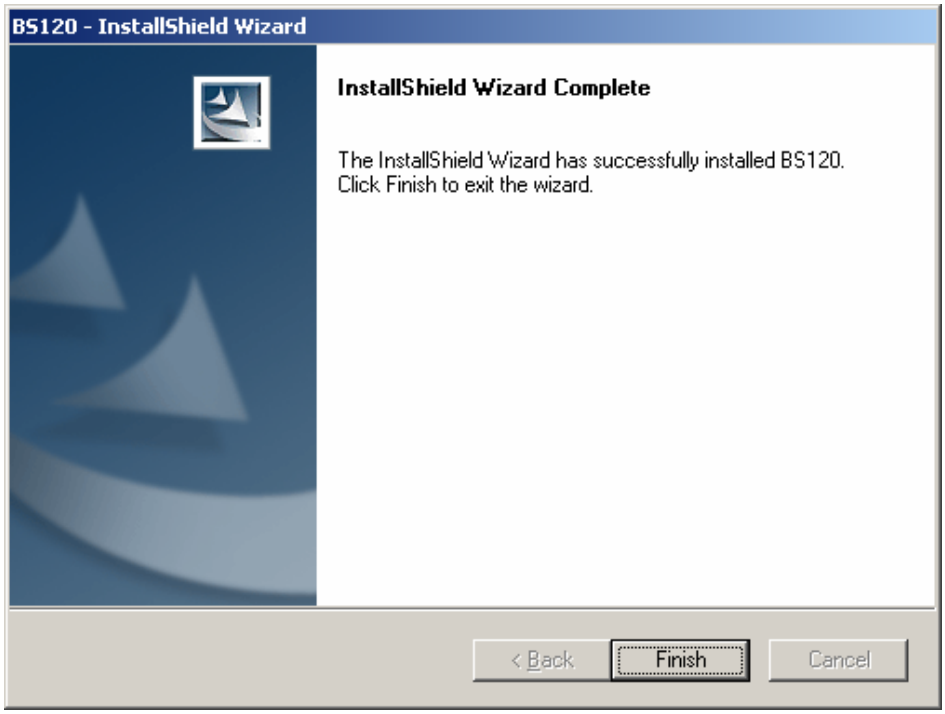
  3）Click ***Change…*** to modify the installation directory or click ***Next*** to enter the next screen.



4）Click ***Back*** to return to the last step to modify the previous setup. Click ***Install*** to start the installation.



5）Click ***Finish*** to complete the installation.



3.3.4 Run Operating Software

- Turn on Main Power and the Power.
- Turn on the printer.
- Make sure the liquid tubes are well connected and there is enough deionized water in the deionized water tank and enough space in the waste tank.
- After logging on the Windows operating system, double-click the shortcut icon of the operating software on the desktop or select the BS-120/BS-130/BS-180/BS-190 operating software program from [Start] to start up the BS-120/BS-130/BS-180/BS-190 operating software.
- After start-up, the analyzer will automatically conduct the following procedures: checking the operating system and the screen resolution, closing the screen saver, checking the color configuration, initializing the database and examining the printer.

NOTE

The screen resolution must be 1024x768. The color configuration must be at least 8 bits.

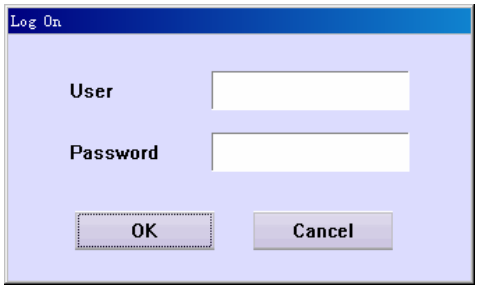
- If all checkings are passed, the following dialog box is displayed. Enter the username and password, and then click ***OK***. For service personnels, log in with the maintenance username. Username: bs120, Password: Bs120@Mindray!.

NOTE

While entering the username and the password, pay attention to the letter case. Capital letters and small letters are different.

The username and password are for service personnels. Do not release them to customers. Users can only use Admin or other usernames set by Admin users to log in.

Figure 3-6 User Log-in Dialog Box



- Enter the username and password, and then click ***OK*** to initialize the system and then operate according to the prompting screen until the main screen of the operating software is displayed.
- After that, wait about 20 minutes until the light source is stable and the reaction disk temperature reaches 37℃, then the tests can be run. When the lamp is stable, enter the Maitenance screen and click . Operate as the software instructs to complete refreshing of the lamp background.

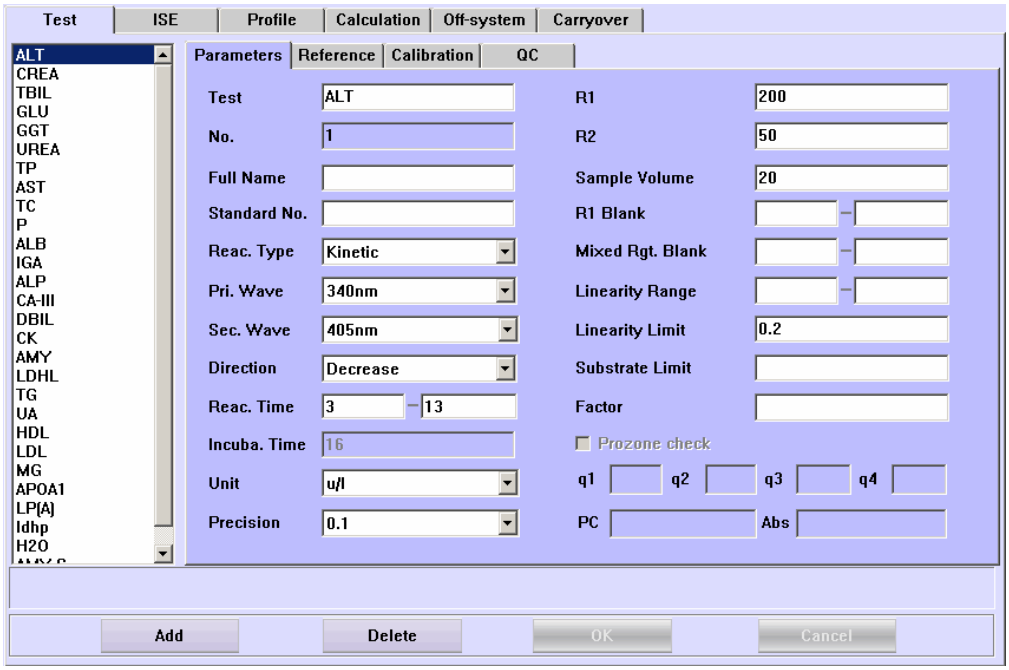
3.3.5 Setting up the System

Before requesting tests, perform the following steps to finish the settings:

- ✓ To set the options regarding the basic parameters of the system, click ***Setup*** → ***System***.
- ✓ To set the options regarding the hospital and doctor information, click ***Setup*** → ***Hospital***.
- ✓ To set the options regarding parameters of calibrators, click ***Calibration*** → ***Calibrator***.
- ✓ To set the options regarding parameters of controls, click ***QC*** → ***Control***.
- ✓ To set the options regarding test parameters, reference, calibration rule and quality control (QC) rule, click ***Parameter*** → ***Test***.
- ✓ To set the options regarding the reagent parameters, click ***Reagent***.
- ✓ To set the options regarding the carryover information among tests, click ***Parameter*** → ***Carryover***.
- ✓ To set the options regarding the printing parameters, click ***Setup*** → ***Print***.

The ***Test*** screen is where you can set test parameters, reference ranges, calibration and QC rules of tests.The ***Test*** screen includes the following tabs: ***Parameters***, ***Reference***, ***Calibration***, ***QC***. The ***Parameters*** will be explained in the following figure.

Figure 3-7 Parameters Screen



The following table explains the parameters on the ***Parameters*** screen.

NOTE

Please set parameters according to instructions of reagents. Improper settings may lead to unreliable test results.

Parameter	Description
Test	Name of the test.
No.	No. of the test. It cannot be edited.
Full Name	Full name of the test. It can be void.
Standard No.	Standard No. of the test. It can be void.
Reac. Type	Analyzing method, including Endpoint, Fixed-time and Kinetic.
Pri. Wave.	Primary wavelength to be used on the test.
Sec. Wave.	Secondary wavelength to be used on the test. It can be void.
Direction	It refers to the changing direction of the absorbance during the reaction process. If the absorbance increases, select ***Increase***; otherwise, select ***Decrease***.

Parameter	Description
Reac. Time	The unit is the interval of collecting photometric data, which equals to 18 seconds for BS-120/BS-130 and 16.3 seconds for BS-180/BS-190. The first edit box is start time, and the second one is end time. For the Endpoint method, the reaction time refers to the interval between the start of the reaction and the end of the reaction. For the Kinetic or Fixed-time method, the reaction time refers to the interval between the point when the reaction becomes stabilized and the point when the reaction is no longer monitored. If the reaction time is negative, it means that you should deduct the reagent blank or sample blank. For the single-reagent test, the analyzer defines the photometric data collection point as 0 exactly before the sample has been dispensed, that is, “0” means the reagent blank point. The value must not be negative For the double-reagent test, the analyzer defines the photometric data collection point as 0 exactly after the second reagent has been dispensed. The value can be negative.
Incuba. Time	The system assigns the incubation time as 5 minutes.
Unit	Unit of the result.
Precision	Precision of the result.
R1	It refers to the volume of the first reagent to be dispensed for the reaction. Increment is 1. BS-120/BS-130: 180-450μl BS-180/BS-190: 150-450μl
R2	It refers to the volume of the second reagent to be dispensed for the reaction. Increment is 1. BS-120/BS-130: 30-450μ BS-180/BS-190: 5-450μl
Sample Volume	It refers to the sample volume (3-45μl) to be dispensed for the reaction. Increment is 0.5.

NOTE

The sum of the entered ***R1***, ***Sample Volume*** and ***R2*** (as needed) must be as follows:

213μl-500μl for BS-120/BS-130

158μl-500μl for BS-180/BS-190

Parameter	Description
R1 Blank	It refers to the allowed absorbance range of the R1 blank. (R1 refers to the reagent of a single-reagent test or the first reagent of a double-reagent test)
	The first edit box is the low limit; the second one is the high limit. Void means no check.
Mixed Rgt. Blank	It refers to the allowed absorbance range of the mixture of the double-reagent test.
	The first edit box is the low limit, and the second one is the high limit. Void means no check.
Linearity Range	It refers to the range in which the test result is linear with the response.
	The first edit box is the low limit, and the second one is the high limit. Void means no check.
Linearity Limit	It applies to the Kinetic method only. It ranges from 0 to 1.
Substrate Limit	It refers to the maximum absorbance change relative to the starting point (the first point when the last reactant is added and the mixing is done).
	It applies to the Kinetic and Fixed-time methods only. It ranges from 0 to 50,000.
Factor	For the test with a pre-set calculation factor, you can directly run it without running the calibration first.
	Void means the calculation factor is invalid.
Prozone check	Select to check the prozone.
	The following parameters are available only when it is selected.
q1	Prozone test point q1.
	It is available when the ***Prozone check*** is selected.
q2	Prozone test point q2.
	It is available when the ***Prozone check*** is selected.
q3	Prozone test point q3.
	It is available when the ***Prozone check*** is selected.
q4	Prozone test point q4.
	It is available when the ***Prozone check*** is selected.
PC	Prozone limit PC.
	It is available when the Prozone check is selected.
Abs	Lower limit of prozone absorbance.
	It is available when the Prozone check is selected.

NOTE

If the ***Factor*** is set, be sure not to set calibration rules at the ***Calibration*** screen. Otherwise, the analyzer will run the calibration test to obtain calibration parameters rather than calculate them with the ***Factor***.

3.3.6 Test

Check the photometric system to ensure that it works properly before performing the tests. Refer to *4.6.4.4 Checking Performance of Photemeter* to get the operation step.

When the instrument is stalled for the first time, execute mechnical resetting for several times, the liquid path can be primed with wash solution (***Maintenance→ Alignment→System***).

Before starting the test, be sure to load the conresponding reagent, sample, calibrator and control to their assigned positions on the sample/reagent disk. Remember to remove the cap of reagent bottle. If the users set the function of enhanced wash, the enhanced wash solution must be placed on the No.35 of sample/reagent disk, and if the users request auto-prediluted test, the distilled water must be placed on the No.36 of sample/reagent disk so as to use it as diluent.

◆ Calibration

Run calibration when necessary.

NOTE

You need to run calibration test again when the measurement conditions such as reagent lot, test parameters, light source and so on are changed.

To request calibrations, click ***Calibration → Calibration Request***.

After requesting calibrations, you should load corresponding calibrators to their assigned positions on the sample disk.

To run calibrations, click ***Start***.

To view the calibration results, click ***Calibration → Results***.

◆ Samples

To request samples, click ***Sample Request***.

Note: STAT samples are requested in the same way as routine ones except that ***STAT*** on the ***Sample Request*** screen should be selected when requesting.

After requesting, you should load corresponding samples to their assigned positions on the sample disk.

To run samples, click ***Start***.

To view the sample results, click ***Results***.

◆ **QC**

To request QCs, click ***QC Request***.

After requesting QCs, you should load corresponding controls to their assigned positions on the sample disk.

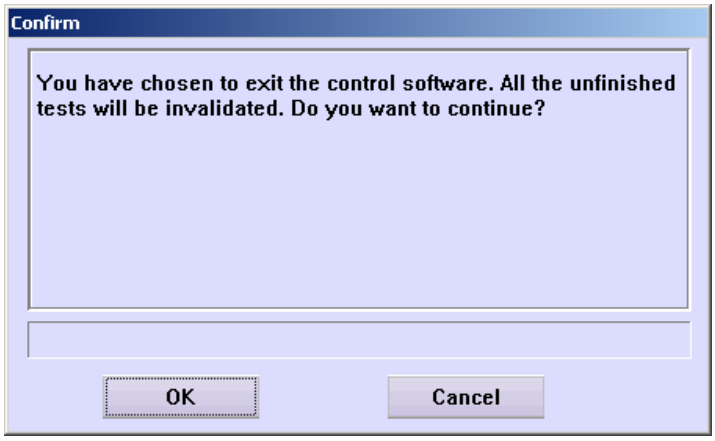
To run QCs, click ***Start***.

To view the QC results, click ***QC*** → ***Real-time***/ ***Daily QC*** / ***Day to Day QC***.

3.3.7 Exit the System

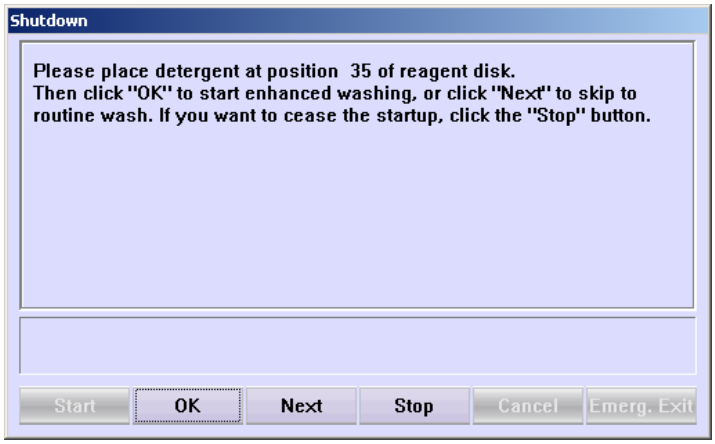
Click ***Exit*** to pop up the dialog box, as shown in Figure 3-8. Before exiting, make sure there is no test running.

Figure 3-8 Confirm Dialog Box



- Click ***OK*** in Figure 3-8 to exit the operating software and then the dialog box, as shown in Figure 3-9, will pop up. Operate according to instructions demonstrated in the following dialog box until exiting the operating software. Click ***Cancel*** in Figure 3-8 to cancel exiting.

Figure 3-9 Shutdown Dialog Box

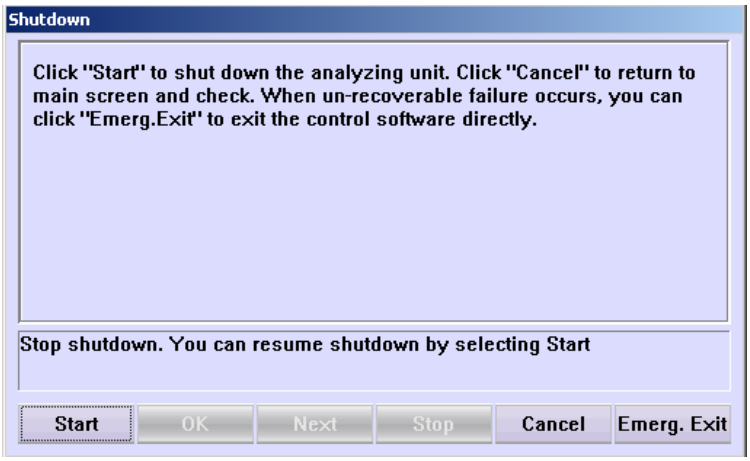


- For service personnels, the emergent exit is available. Click ***stop*** in Figure 3-9 and the dialog box will pop up, as shown in Figure 3-10, and then click ***Emerg.Exit*** in Figure 3-10 to exit quickly.

  NOTE: The analyzer does not execute any routine exiting procedures when ***Emerg.Exit.*** is chosen. General users should exit the operating software

normally, that is, to follow the exiting prompt shown in dialog box to complete the exiting procedures, including cuvettes replacement, washing, turning off the light and so on.

Figure 3-10 Emergent Exit Dialog Box



- After exiting the operating software, turn off the power of the printer, the operation unit (personal computer), the display and the analyzing unit (analyzer) in turn.
- The main power of analyzer should be kept on if the reagents are held in the sample/reagent disk so as to keep cooling the reagents. If the reagents are taken out to store in other place, the main power could be turned off.

NOTE：

The refrigerator still functions after the Power is turned off. To shut down the refrigerator, turn off the Main Power.

4 Units Description

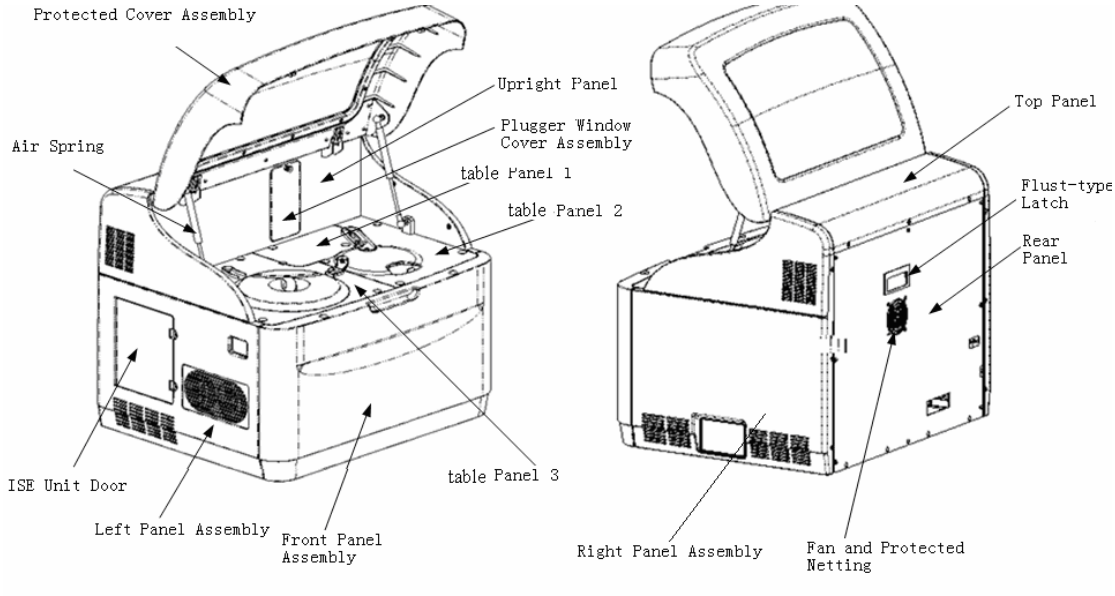
4.1 Enclosure and Panel Unit

The maintenance and replacement of major components or parts need removing some enclosure and panels. Therefore, the disassembly and installation of the enclosure and panels are intruduced first.

4.1.1 Components

The outside of analyzer consists of the enclosure and panel unit, which protects the inner parts of the analyzer and provides dustproof function. The enclosure and panel unit consists of the protected cover, table panel, left panel, right panel, front panel, top panel, and rear panel. See Figure 4-1.

Figure 4-1 Structure of Enclosure and Panel Unit



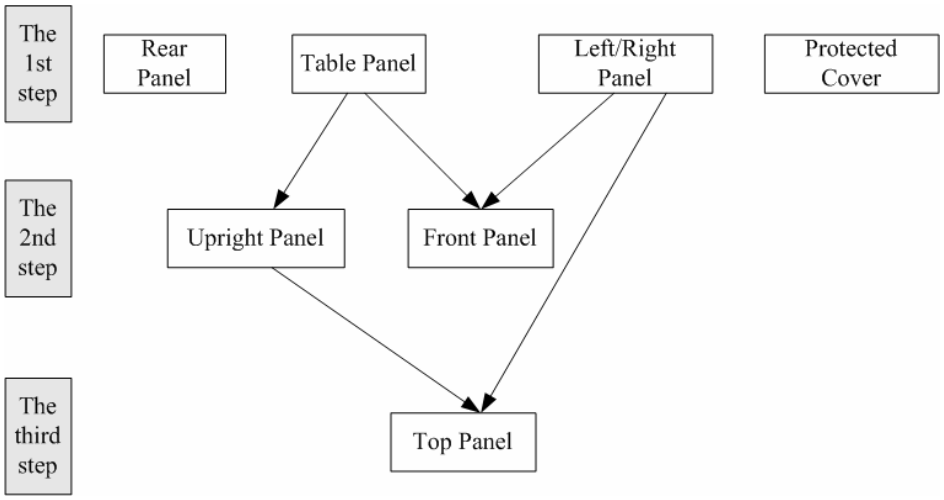
4.1.2 Dismounting/Mounting of Enclosure Unit

If you need to maintain the inner parts or enclosure parts of analyzer, please turn off the Power and Main Power, and then carry out the procedures shown in Figure 4-2.

CAUTION

Please turn off the analyzer Power and Main Power before dismounting or mounting the enclosure and panels.

Figure 4-2 Procedures for Removing Enclosure and Panel Uniit



Usually, do not remove the protected cover because it does not affect the dismounting of other components. If necessary, please remove one end of the air spring first, and then remove the fastening screws between the framework and gemel assembly.

The dismounting of rear panel is simple and relatively independent on other panels. First, unplug the power cable and COM cable on the rear panel, and then dismount the fastening screws in rear panel. Thus the rear panel can be taken out. For convenient operation, you can take the flust-type latch in rear panel to remove it. Be sure to pull out the fan wire plug before removing the rear panel.

4.1.2.1 Dismounting/Mounting Left /Right Panel

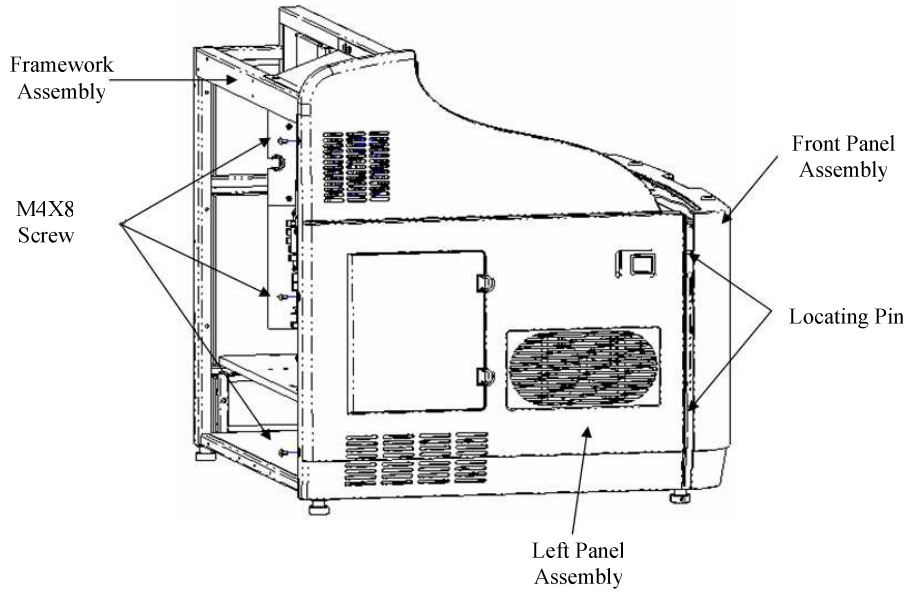
a. Dismount the screws which connect the left panel and the framework. See Figure 4-3.

b. Move the left panel assembly back until the locating pin and latch hook are departed from the holes of front panel and framework respectively, and then take out the left panel assembly.

c. To mount left panel, just reverse the dismounting procedures.

d. The procedures to dismount/mount the right panel are the same as that of left panel.

Figure 4-3 Removing Left Panel Assembly



4.1.2.2 Dismounting/Mounting Table Panel

CAUTION

While removing and installing the front plate, pay great attention to the sample probe and the mixing bar to avoid injury resulting from collision with them. Move the sample probe and mixing bar to the safe place before operation.

The table panel assembly consists of panel 1, panel 2, and panel 3. See Figure 4-1.

Dismounting/mounting procedures：

a. Remove the screw caps in table panel.

b. Loosen the screws under the screw caps.

c. Remove the table panel 1, table panel 2 and table panel 3 in turn.

d. Reverse above procedures to mount the table panel.

Precautions:

1. Make sure that every gap between two panels is uniform and the sampling and mixing holes in panel 2 aim at the holes in reaction disk correspondingly.

2. The mounting and dismounting of the table panel should follow the order mentioned above. That is, when dismounting, the procedure should follow table 1 to panel2 to panel3. Mouting procedure should follow the reverse.

4.1.2.3 Dismounting/Mounting Front Panel Assembly

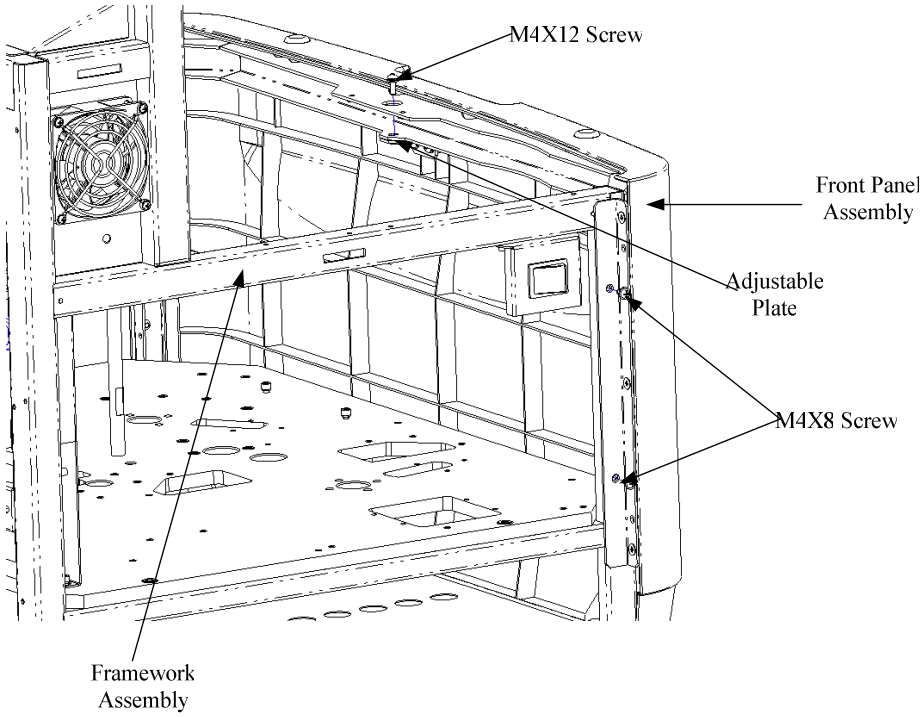
The procedures are shown as follows.

a. Remove table panel, left panel and right panel.

b. Loosen the fastening screws between the panel assembly and framework assembly (see Figure 4-4).

c. When mounting them, reverse steps described above.

Figure 4-4 Removing Front Panel



4.1.2.4 Dismounting/Mounting Upright Panel and Top Panel

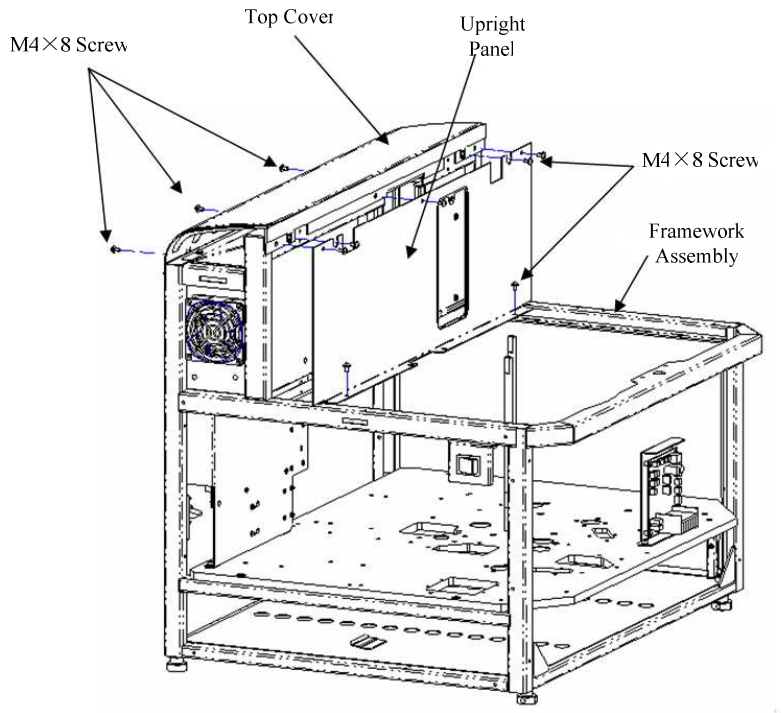
The dismounting/mounting procedures are described as follows.

a. After removing the table panel, loosen all the screws in upright panel and remove the upright panel. See Figure 4-5.

b. After removing the left panel assembly and right panel assembly, loosen the three screws on the back of top panel and remove the top panel.

c. To mount them, follow the sequence of top panel, upright panel, left and right panel.

Figure 4-5 Removing Upright Panel and Top Cover



4.2 Probe Unit

4.2.1 Function Introduction

Probe unit includes the probe, which aspirates sample from the sample tube or reagent from the reagent bottle and then dispenses the sample or reagent into reaction cuvette; and also aspirates the sample from the sample tube and then dispenses it into ISE unit if the analyzer has installed the ISE unit.

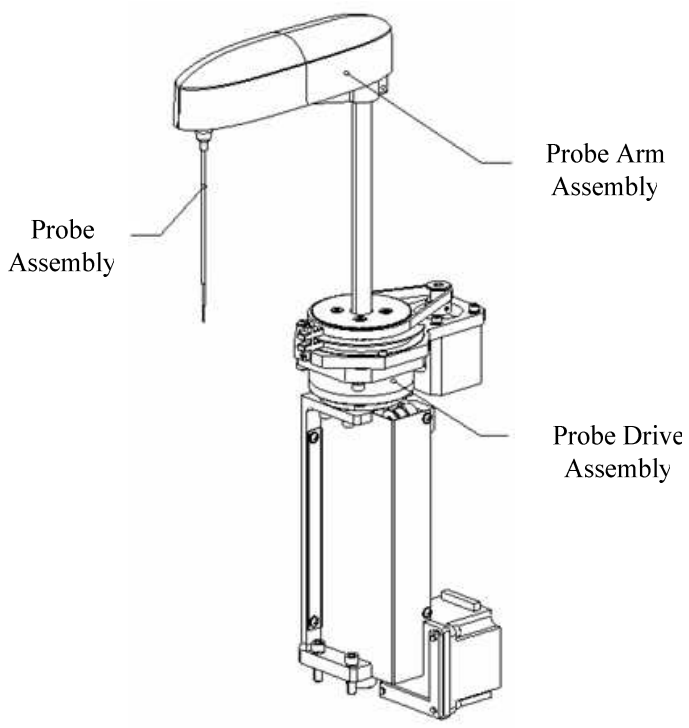
The probe also has the function of detecting liquid level, protecting the probe against collision in the vertical direction and tracking liquid level. What's more, the probe is also able to limit its mechanical motion and lock itself when the power failure occurs.

The general workflow of the probe assembly is from wash pool to sample aspirating position, and then to reaction disk dispensing position and ISE dispensing position.

4.2.2 Components of Probe Unit

The probe unit consists of the probe drive assembly, probe arm assembly, and probe assembly. See Figure 4-6.

Figure 4-6 Components of Probe Unit



Probe Drive Assembly: Probe drive assembly supports the probe arm assembly and drives probe arm assembly to move vertically or horizontally, so the probe can reach different expected positions. Probe drive assembly includes the horizontal movement structure and vertical movement structure. Both structures consist of stepping motors, synchronous belt wheel and synchronous belt. Integrated with a bracket, the two structures finally drive probe arm assembly to move vertically or horizontally via the spline shaft.

Probe Arm Assembly: Probe arm assembly is composed of the preheating module, liquid level detection board, arm cover, etc, which are integrated with the arm base.

Probe Assembly: Probe assembly is fixed to probe arm assembly by the guiding pole and obstruction spring.

4.2.3 Dismounting/mounting Sample Probe Unit

WARNING

The probe tip is sharp and can cause puncture wounds. Pay great attention to prevent injury when working around the probe.

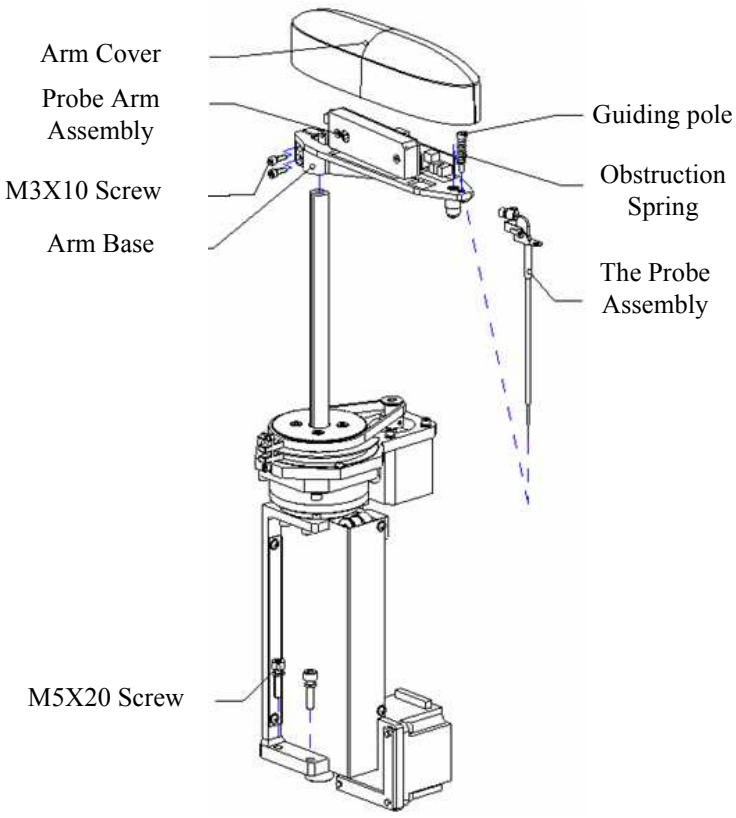
WARNING

Wear anti-static gloves or take other protective measures when removing or touching the circuit board.

BIOHAZARD

Do not touch the probe. If necessary, wear gloves.

Figure 4-7 Dismounting of Sample Probe Unit



Dismounting steps are shown as follows.

a. The probe assembly is fixed to the probe arm assembly by the guiding pole and obstruction spring. Remove the probe assembly by removing the arm cover, guiding pole and obstruction spring.

b. The probe arm assembly is fixed to the probe drive assembly with two M3X10 hexagon socket head screws allocated with spring pad. Remove the probe arm assembly by loosening the two socket screws.

c. The sample probe unit is fixed to base board via three M5X20 hexagon socket head screws allocated with spring pad. Remove the sample probe unit by loosening the three socket screws.

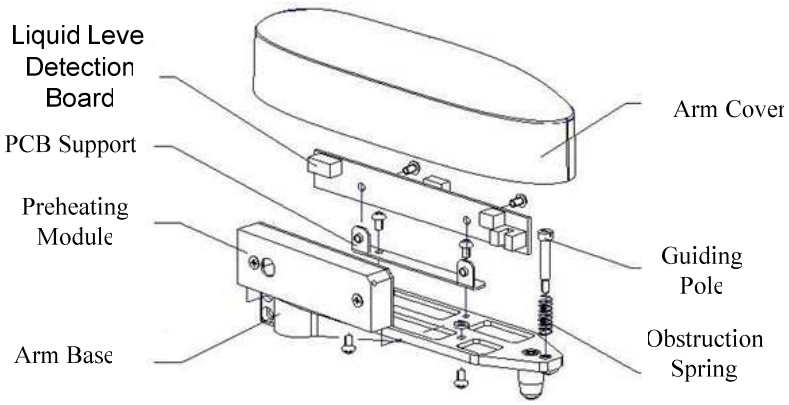
Reverse the steps described above to mount the sample probe unit.

Precautions:

1. After installing the probe into guiding pole with obstruction spring, make sure probe assembly move freely up and down. If not, you should adjust the guiding pole to make it move freely. Otherwise the function of protecting the probe against collision in the vertical direction may not work well.
2. Make sure that the probe surface is clean while removing and installing the probe assembly.
3. Disconnecting correlative power cables, data cables and liquid connecting before performing the above steps.

4.2.3.1 Dismounting/mounting Probe Arm Assembly

Figure 4-8 Probe Arm Assembly



Dismounting steps are shown as follows.

a. The liquid level detection board is fixed to the PCB support via two M3X5 cross pan head screws. Remove it after removing the arm cover and loosening the two cross pan head screws.

b. The preheating module is fixed to the arm base via two M3X8 cross pan head screws. Remove it after removing the arm cover and loosening the two cross pan head screws.

c. Reverse the steps described above to mount the probe arm seembly.

Precautions:

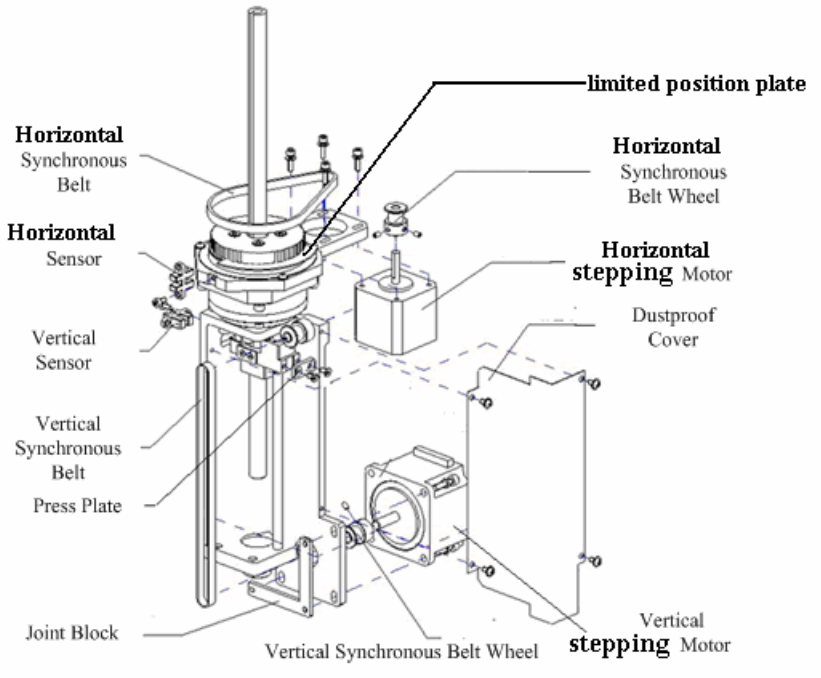
a. There are two heat insulation plates between the preheating module and the arm base.

b. The end of the obstruction spring, against which spring wire is pressed tightly, should be faced down while installing the obstruction spring.

c. Disconnecting correlative power cables, data cables and liquid connecting before performing the above steps.

4.2.3.2 Probe Drive Assembly

Figure 4-9 Probe Drive Assembly



Dismounting steps are discribed as follows.

A. The horizontal stepping motor is fixed to the motor support with four M3X12 hexagon socket head screws allocated with plain pad and spring pad. First, remove the horizontal stepping motor by loosening the four screws, and then take out the horizontal synchronous belt, and then remove the horizontal synchronous belt wheel which is fixed to horizontal stepping motor by loosening two M3x5 hexagon socket head set screws.

B. The vertical stepping motor is fixed to the bracket with three M4X16 hexagon socket head screws allocated with plain pad and spring pad. First, remove the vertical stepping motor by loosening the three screws, and then remove the vertical synchronous belt wheel which is fixed to vertical stepping motor by loosening two M3x5 hexagon socket head set screws.

C. Remove the dustproof cover by loosening four M3x6 cross pan head screws, and then remove the press plate by loosening two M3x6 cross countersunk head screws, and finally take out the vertical synchronous belt.

D. The horizontal senor is fixed to the motor support with one M3X6 hexagon socket head screw. Remove horizontal sensor by loosening the screw. The vertical sensor is fixed to the bracket using one M3X6 hexagon socket head screw. Remove vertical sensor by loosening the screw.

E. The limited position plate which is fixed by three M3X6 cross pan head screws can adjust horizontal position of the probe arm assembly.

F. Reverse the steps described above to mount the probe drive assembly.

Precautions:

1. The synchronous belt wheel which is fixed to stepping motor should keep the same installation height with the matched belt wheel so that the belt does not bear twisting force.

2. Use the BA30-K22 fixture to get appropriate tensile force of horizontal synchronous belt and use the the BA30-K21 fixture to get appropriate tensile force of vertical synchronous belt.

3. The direction of horizontal and vertical stepping motors' plug should face outside and upside respectively.

4. Disconnect correlative power cables, data cables and liquid connecting before performing the above steps.

4.3 Sample/Reagent Disk Unit

4.3.1 Function Introduction

The sample/reagent disk unit holds the sample tubes and reagent bottles and carries them to the specified position for aspirating sample or reagent. At the same time it is capable of refrigerating so as to keep the reagent stable and prevent it from volatilization.

1. Holding sample tubes: Sample containers (tube, microtube, etc) are placed on the sample/reagent disk unit, and then the sample probe unit aspirates sample and dispenses them into reaction cuvette.

2. Holding reagent bottles: Reagent bottles are placed on the sample/reagent disk unit, and then the sample probe unit aspirates reagent and dispenses them into reaction cuvette.

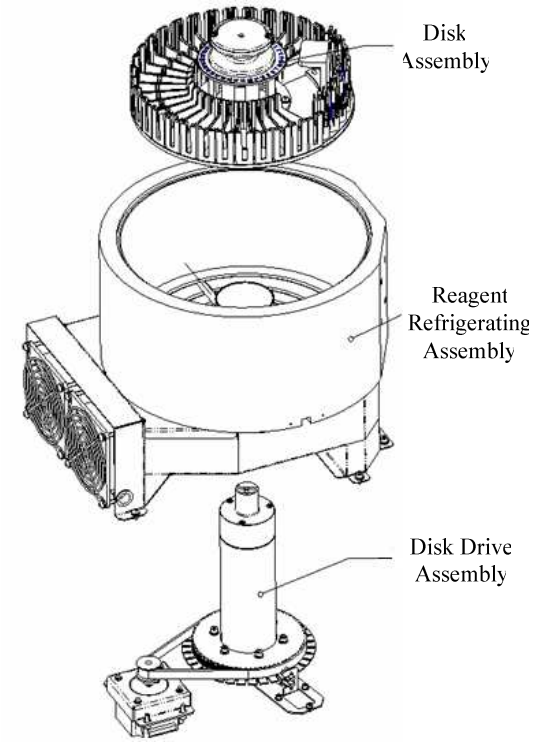
3. Programmed feeding: The sample/reageng disk unit carries specified sample tubes or reagent bottles to the aspirating position for aspirating according to the programmed period. The sample/reagent disk is driven by the drive assembly.

4. Reagent refrigerating: The sample/reagent disk unit is capable of refrigerating and keeping the reagents at 4-15° C for 24 hours a day so that the reagents are always stable and not volatilized.

4.3.2 Components of Sample/Reagent Disk Unit

The sample/reagent disk unit consists of reagent refrigerating assembly, disk drive assembly and disk assembly. See Figure 4-10.

Figure 4-10 Sample/Reagent Disk Unit



Reagent Refrigerating Assembly: The reagent refrigerating assembly is used to provide refrigeration function and keep the reagents in a low-temperature environment, so that the reagent are kept stable and will not be volatilized. The reagent refrigerating assembly consists of refrigeration compartment assembly, refrigeration plate, air duct and fan assembly.

Disk Drive Assembly: The disk drive assembly can carry specified sample tube or reagent bottle to the aspirating position for aspirating according to programmed period. The disk drive assembly consists of drive shaft assembly, sensor assembly, motor assembly, synchronous belt and coder.

Disk Assembly: Disk assembly is used to hold reagent bottles or sample tubes and rotates counter-clockwise, carrying each reagent bottle or sample tube to the aspirating position when needed. The disk assembly includes the handle assembly, reagent disk assembly and sample disk assembly.

4.3.3 Dismounting Sample/Reagent Disk Unit

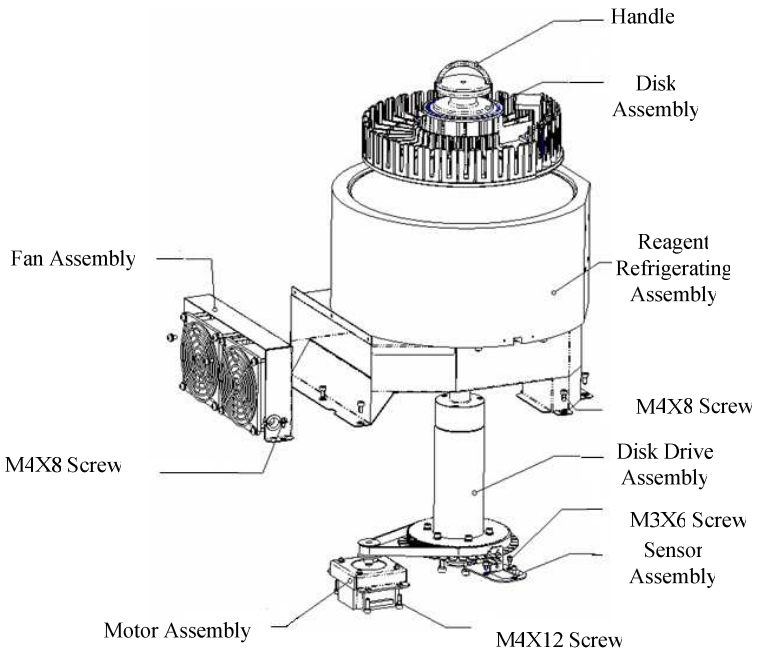
CAUTION

The probe tip is sharp and can cause puncture wounds. To prevent injury, move the probe to the safe position before taking out disk assembly.

BIOHAZARD

Do not touch the probe and disk assembly. Please wear gloves if necessary.

Figure 4-11 Sample/Reagent Disk Unit



A. Pull the handle to vertical direction and take out the disk assembly.

B. Remove the fan assembly by loosening five M4x8 cross pan head screws.

C. Remove the reagent refrigerating assembly by loosening seven M4x8 hexagon socket head screws.

D. Remove the sensor assembly by loosening three M3x6 hexagon socket head screws.

E. Remove the motor assembly by loosening four M4x12 hexagon socket head screws.

F. Mounting the Sample/Reagent Disk Unit follows the reserve steps described as above

Precautions:

Adjust tensile force of the synchronous belt while mounting the motor assembly.

4.3.3.1 Reagent Refrigerating Assembly

Figure 4-12 Reagent Refrigerating Assembly

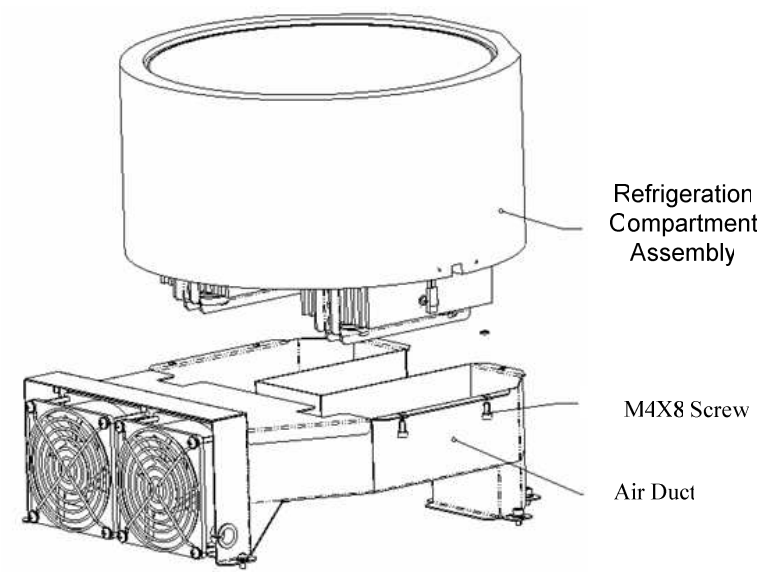
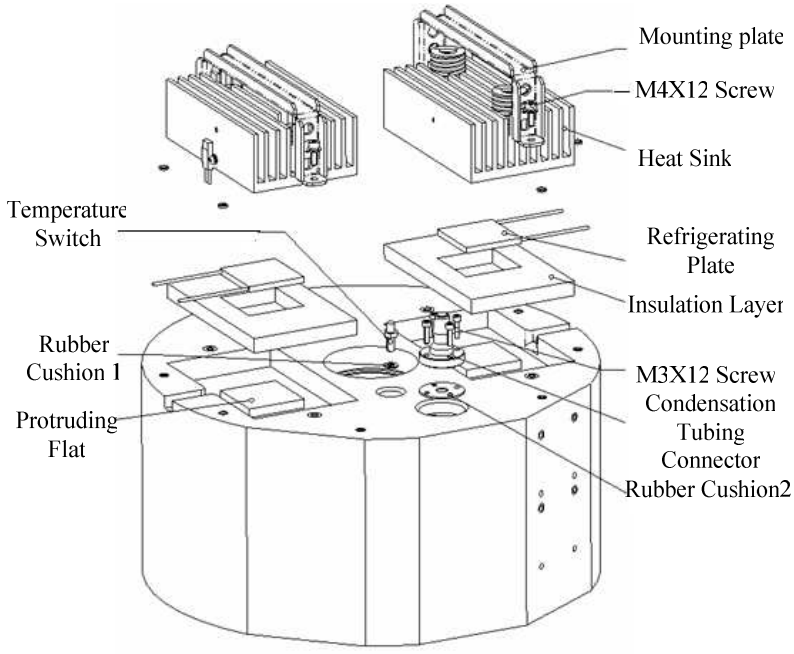


Figure 4-13 Refrigeration Components



The main components of reagent refrigerating assembly that need to be maintained include refrigerating plate, temperature switch and condensing tube connector. The steps of discounting are shown as follows.

1. Remove the refrigeration compartment assembly which is fixed to air duct by loosening four M4x8 hexagon socket head screws.

2. Remove the water-proof glue in the circumference of condensing tube connector and four M3x12 cross pan head screws. After replacing the condensing tube connector,

apply some water-proof glue in its circumference when installation.

3. Remove the water-proof glue in the circumference of temperature switch. After replacing the temperature switch, apply the water-proof glue in its circumference.

4. Remove the water-proof glue in the circumference of radiator, four M4x12 hexagon socket head screws, radiator and insulation layer in turn, and then replace the refrigerating plate. You must coat the two sides of the refrigerating plate with heat-conducting glue (0.1-0.2mm thick) before installing the refrigerating plate; the side with word is matched with protruding flat. Apply some water-proof glue in the circumference of radiator after finishing installation.

Precautions:

1. Proper screws should be used. Stainless screws are required.

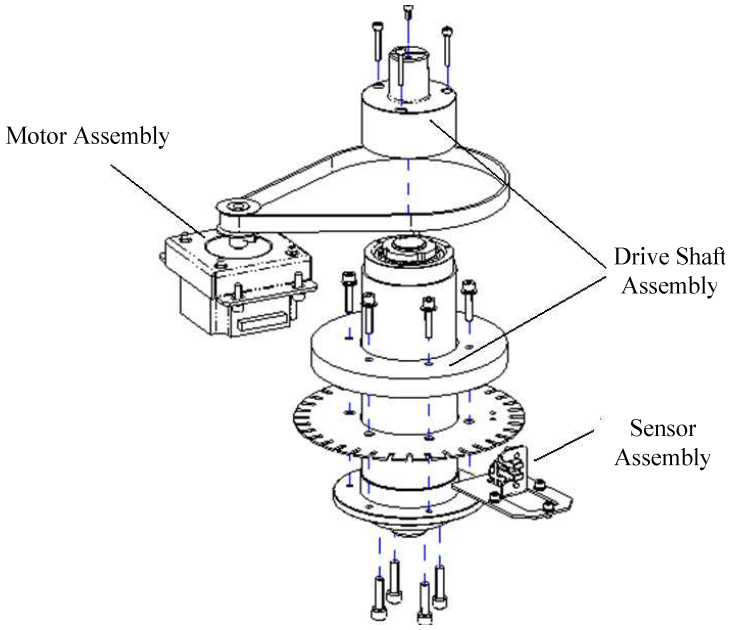
2. The insulation layer should be replaced with a new one while maintaining the refrigerating plate.

3. The refrigerating plate should be installed in the correct direction (the side with words should be matched with protruding flat), otherwise it can not function as expected.

4. To install the refrigerating plate, the screws must be tightened evenly to avoid the damage caused by uneven force when mounting the plate

4.3.3.2 Disk Drive Assembly

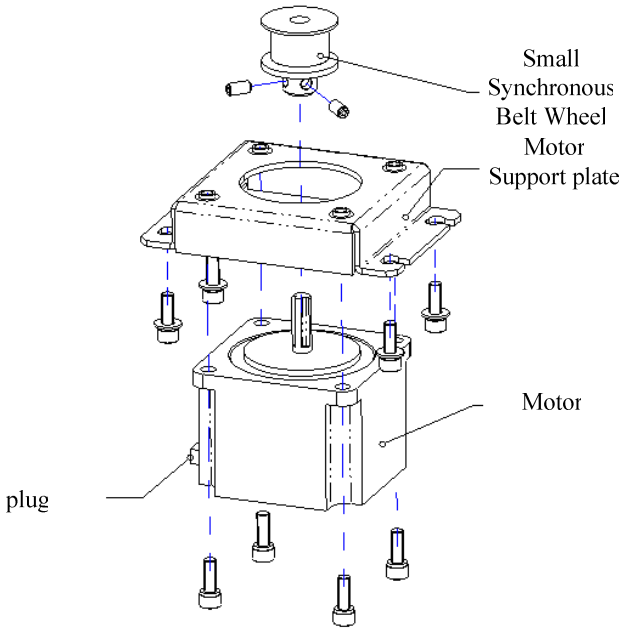
Figure4-14 Disk Drive Assembly



The disk drive assembly includes the motor assembly, sensor assembly and drive shaft assembly. The motor assembly and sensor assembly are main parts that need to be maintained.

Motor Assembly

Figure4-15 Motor Assembly



1. Remove the small synchronous belt wheel by loosening two M3x5 hexagon socket head set screws.
2. The motor is fixed to the motor support plate with four M4X12 hexagon socket head screws.

Precautions:

1. Apply some screw glue while mounting M3x5 hexagon socket head set screws.
2. The installation height of small synchronous belt wheel should be kept the same with the matched belt wheel while installing
3. Adjust tensile force while installing the small synchronous belt wheel.
4. The direction of motor plug faces to the side with bended flange of the motor support plate. See Figure4-15.

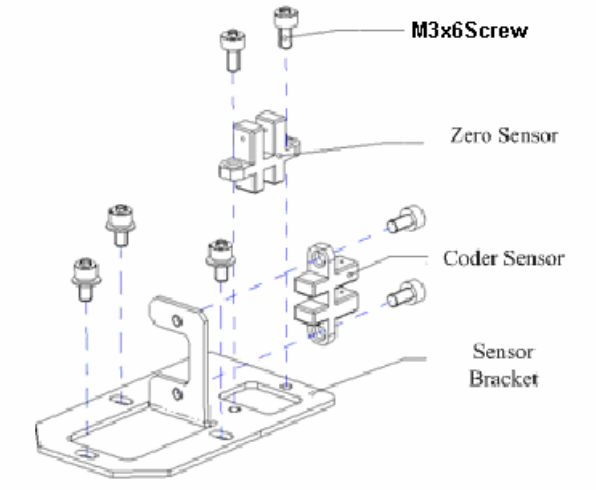
Sensor Assembly

CAUTION

Do not dismount the sensor assembly if not necessary. Otherwise the position of sensor may be changed, which may cause aspirating position changed.

If the position of sensor assembly is changed, the sample aspirating position needs to be re-adjusted.

Figure4-16 Sensor Assembly



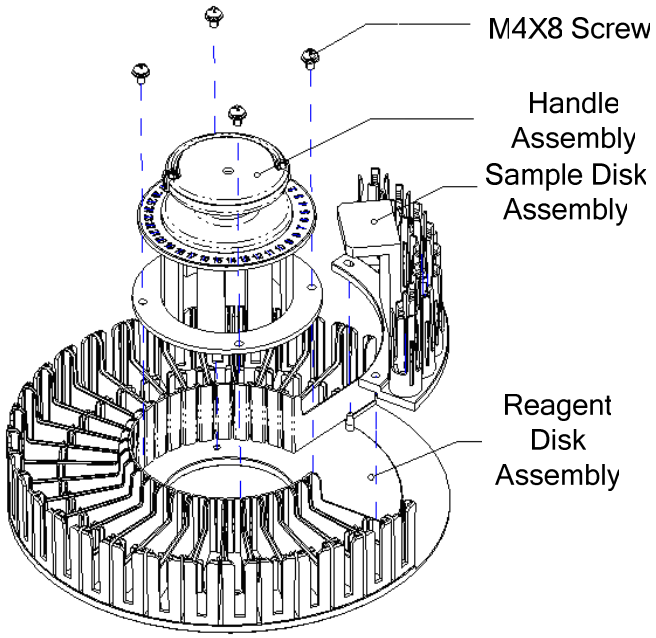
Remove two M3x6 hexagon socket head screws, and then remove the zero sensor and coder sensor which are fixed to the sensor bracket.

Precautions:

The positions of zero sensor and coder sensor can not be changed.

4.3.3.3 Disk Assembly

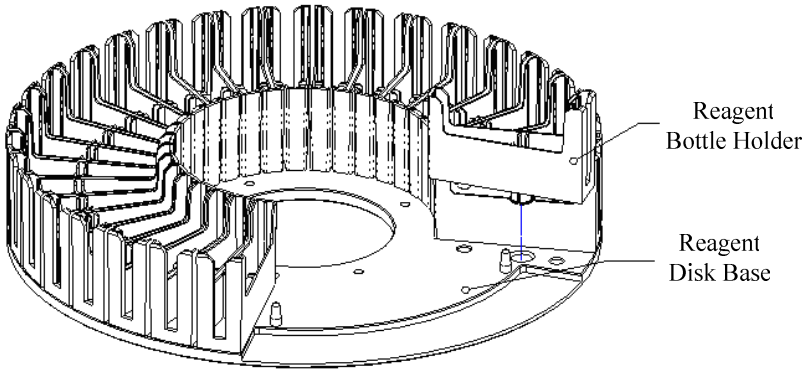
Figure4-17 Sample/Reagent Disk Assembly



Remove the handle assembly which is fixed to reagent disk assembly by loosening four M4x8 cross pan head screws. The sample disk assembly can be taken out from the reagent disk assembly directly. The introduction of reagent disk assembly and sample disk assembly is as follows.

Reagent Disk Assembly

Figure 4-18 Reagent Disk Assembly

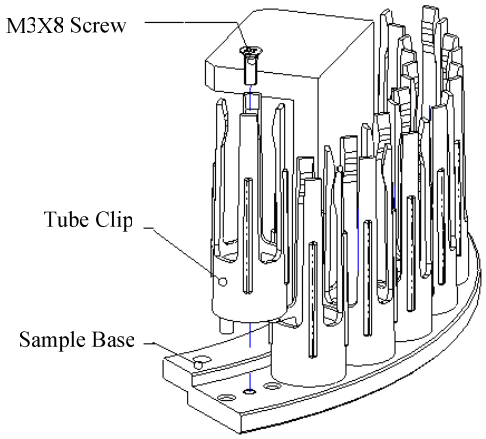


The reagent bottle holder is fastened on the reagent disk base. The reagent bottle holder can be pulled out or pushed in the reagent disk base by hand directly.

Precautions: Make sure that the reagent bottle holder is fastened completely on the reagent disk base.

Sample Disk Assembly

Figure 4-19 Sample Disk Assembly



Remove one M3x8 cross countersunk head screw, and then replace the tube clip which is fixed to the sample base.

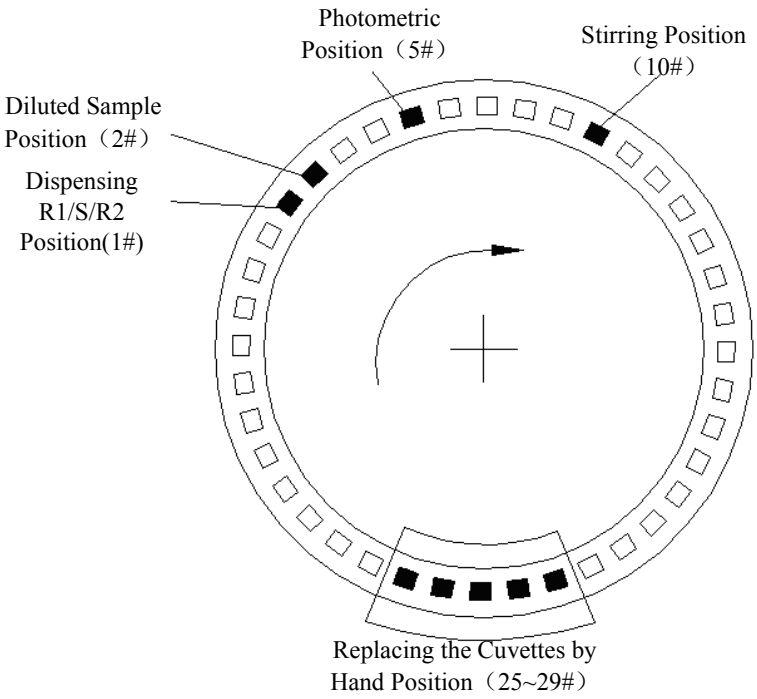
4.4 Reaction Disk Unit

4.4.1 Function Introduction

The reaction disk unit holds reaction cuvettes and rotates clockwise, carrying the cuvettes to specified position for sample/reagent dispensing and stirring. The reagents and the sample react in reaction cuvette. Also the reaction disk unit provides a constant-temperature environment for the reaction.

Figure 4-20 shows the position on the reaction disk. No.1 is dispensing R1/R2/S position. No.2 is aspirating pre-diluted sample position. No.5 is photometric measuring position. No.10 is stirring position. No.25~No.29 is for replacing the cuvettes manually.

Figure 4-20 Working Positions on Reaction Disk



4.4.2 Components of Reaction Disk Unit

The reaction disk unit consists of reaction disk movement assembly and reaction compartment assembly.

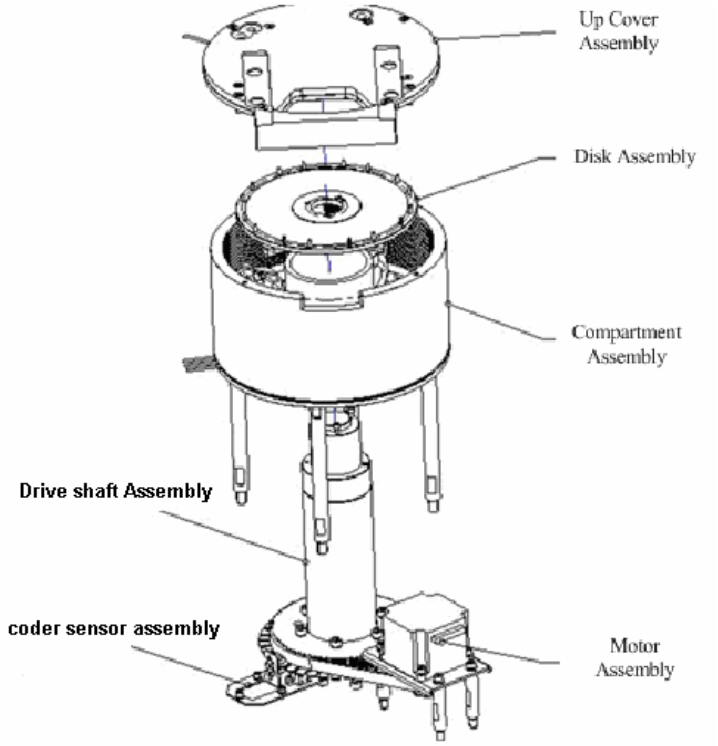
Reaction Disk Movement Assembly: It consists of disk assembly and disk drive assembly. It holds cuvettes and carries them to the expected postion for Sample/Reagent dispensing or stirring. Also the photometric measurement is carried out when the reaction disk is rotating. The disk drive assembly includes the coder sensor assembly, motor assembly and drive shaft assembly.

Coder Sensor Assembly: The function is to find the mechanical zero position and count the valid edges of the coder.

Motor Assembly: It drives the reaction disk to rotate via the belt and the two belt wheels.

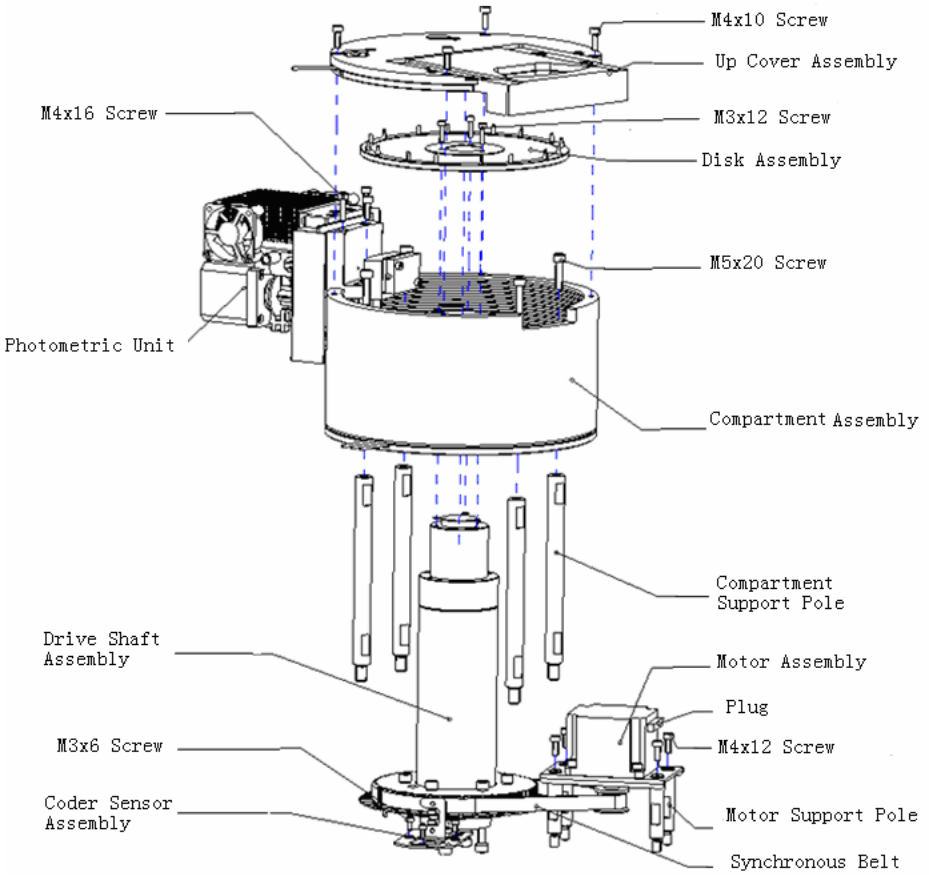
Reaction Compartment Assembly: It provides a constant-temperature environment for the reaction and consists of the compartment assembly and up cover assembly.

Figure 4-21 Reaction Disk Unit



4.4.3 Dismounting Reaction Disk Unit

Figure 4-22 Reaction Disk Unit



The steps are shown as follows.

1. Remove the up cover assembly which is fixed to compartment by loosening four M4x10 hexagon socket head screws.

2. Remove the disk assembly which is fixed to drive shaft assembly by loosening three M3x12 hexagon socket head screws.

3. Remove the photometric unit which is fixed to compartment assembly by loosening three M4x16 hexagon socket head screws.

4. Remove the compartment assembly which is fixed to compartment support pole by loosening four M5x20 hexagon socket head screws.

5. Remove the coder sensor assembly which is fixed to base board by loosening three M3x6 hexagon socket head screws.

6. Remove the motor assembly which is fixed to motor support pole by loosening four M4x12 hexagon socket head screws.

Precautions:

1. Correct direction of plug is required while installing the motor assembly.

2. Proper tensile force is required while installing the synchronous belt.

4.4.3.1 Motor Assembly

The structure and the steps of dismounting motor assembly are similar to the sample/reagent disk. Please refer to the relative content of **Motor Assembly** described in chapter *4.3.3.2*.

4.4.3.2 Coder Sensor Assembly

The steps of dismounting coder sensor assembly are similar to the sample/reagent disk. Please refer to the relative content of **Sensor Assembly** described in chapter *4.3.3.2*.

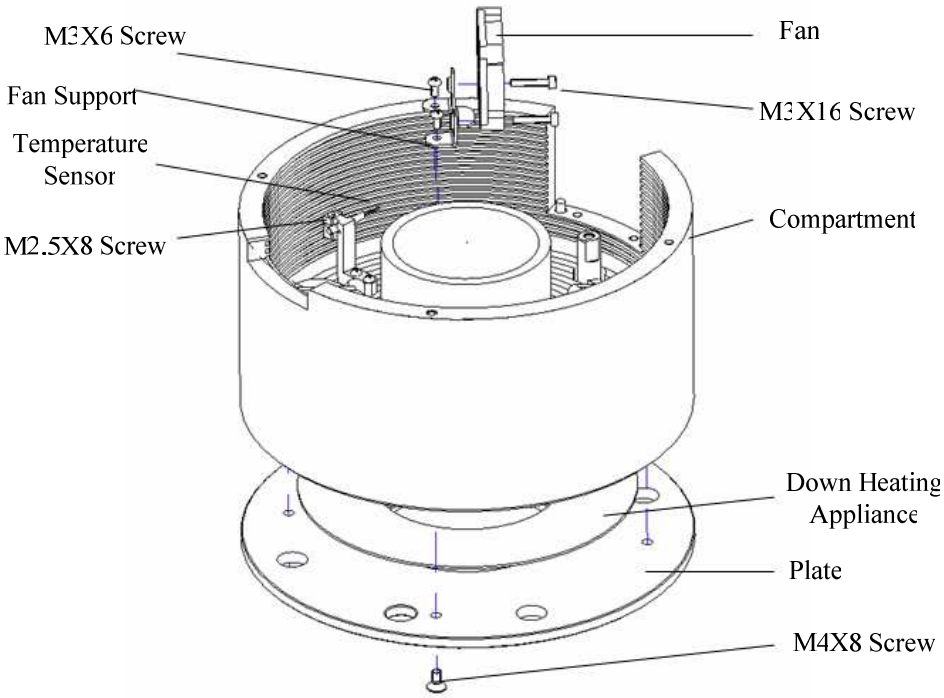
CAUTION

Do not remove the sensor assembly because the position change of sensor may cause the photometric measuring position change.

If the position of sensor assembly is changed, the position of photometric measurement needs to be re-adjusted. For details on adjusting, please refer to *4.6.4.1*.

4.4.3.3 Compartment Assembly

Figure 4-23 Compartment Assembly



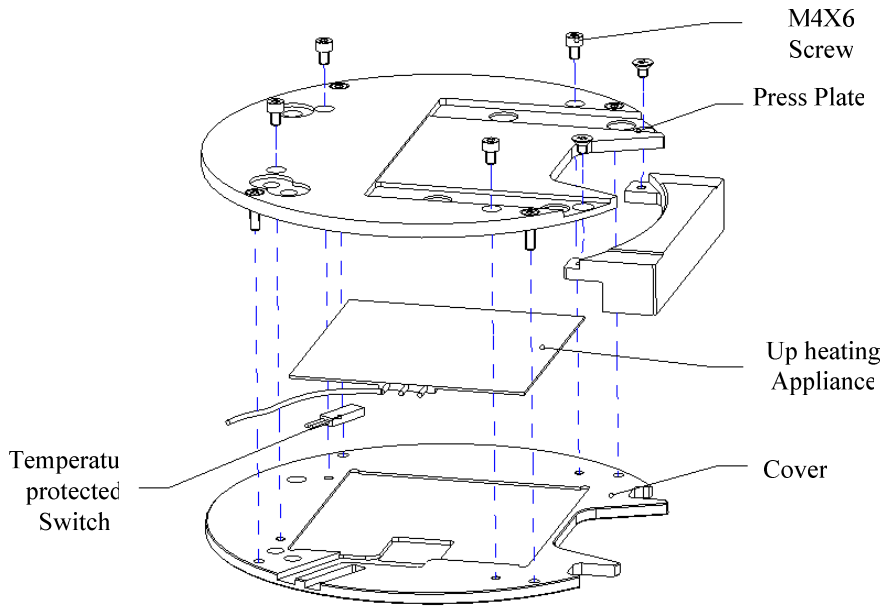
1. Remove the fan support which is fixed to compartment by loosening the two M3x6 pan head screws.
2. Remove the fan which is fixed to fan support by loosening the two M3x16 hexagon socket head screws.
3. Remove the temperature sensor by loosening the M2.5x8 hexagon socket set head screw.
4. Remove the down heating appliance which is fixed to compartment by loosening the four M4x8 hexagon socket set head screws.

Precautions:

1. Do not tighten the M2.5x8 hexagon socket set head screw too tight when mounting the temperature sensor.
2. The side of down heating appliance that is in contact with the compartment must be coated with heat–conducting glue (0.1-0.2mm thick) while installing it.

4.4.3.4 Cover Assembly

Figure 4-24 Cover Assembly



The temperature protective switch and up-heating appliance are installed between the press plate and the cover, and they can be removed by loosening four M4x6 hexagon socket head screws.

Precautions:

1. The side of up-heating appliance that is incontact with the press plate must be coated with heat –conducting glue (0.1-0.2mm thick), and the up-heating appliance cables are placed in the groove of the press plate so as to avoid pressure.

2. The temperature protective switch must be coated with heat-conducting glue (0.1-0.2mm thick), and it should be carefully installed in the specified position while installing.

4.5 Mixing Unit

4.5.1 Function Introduction

The mixing unit is equipped with a mixing bar, which is used to stir the liquid in cuvettes.

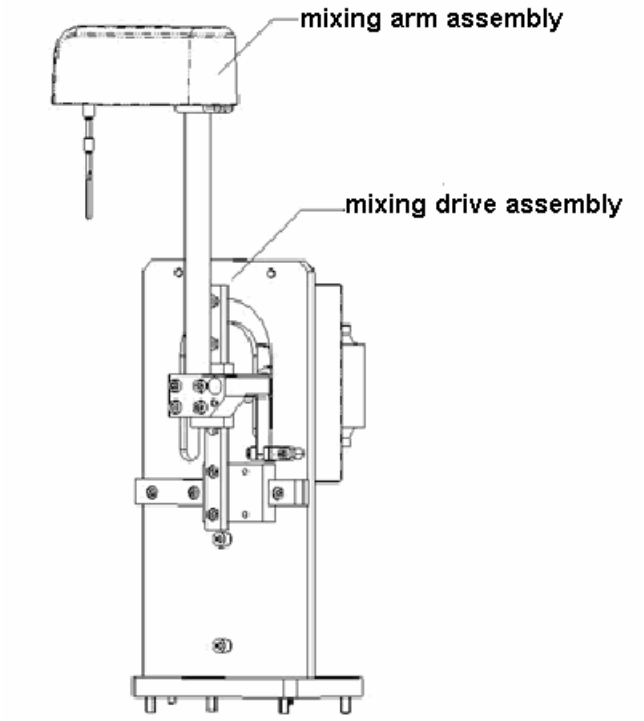
Additionally, the mixing unit has a specified mechanical position and is able to lock itselt when power failure occurs.

The working position of the mixing bar: the wash well and the stirring position

4.5.2 Components of Mixing Unit

The mixing unit consists of mixing drive assembly and mixing arm assembly.

Figure 4-25 Mixing Unit



Mixing drive assembly: It supports the mixing arm assembly and drives the arm to do curvilinear movement in horizontal plane, so that the mixing bar moves between the two working positions. It consists of stepping motor, shaft, bearing, linear guide way, etc, which are integrated by the cam board. The arm shaft transfers movement to the mixing arm assembly.

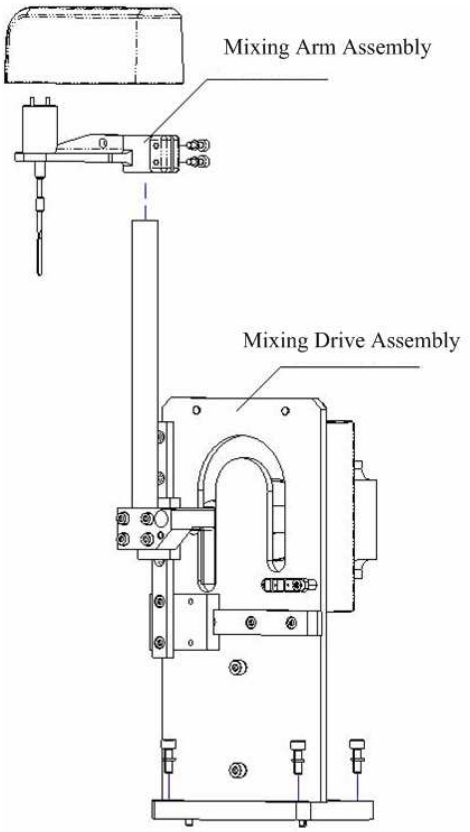
Mixing arm unit: It consists of a mixing bar, motor, cover, etc. and all of them are integrated by the arm base.

4.5.3 Dismounting Mixing Unit

BIOHAZARD

Do not touch the mixing bar.Wear gloves, if necessary.

Figure 4-26 Mixing Unit



1. The mixing arm assembly is fixed on the mixing drive assembly with two M3x10 hexagon socket head screws allocated with plain pad and spring pad. Remove the mixing arm assembly by loosening the two screws.
2. The mixing unit is fixed on the base board with four M4x102 hexagon socket head screws allocated with spring pad. Remove the mixer drive assembly by loosening the two screws.

Precaution:

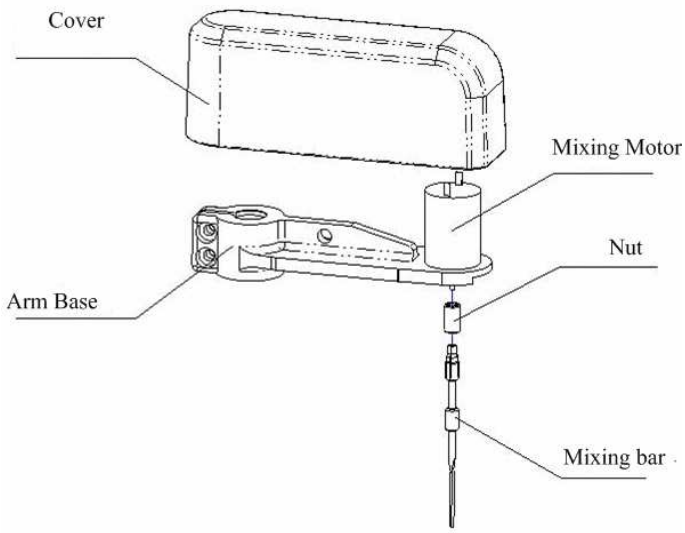
Remove the cables before performing above steps.

4.5.3.1 Mixing Arm Assembly

BIOHAZARD

Do not touch the mixing bar.Wear gloves when necessarily.

Figure 4-27 Mixing arm assembly



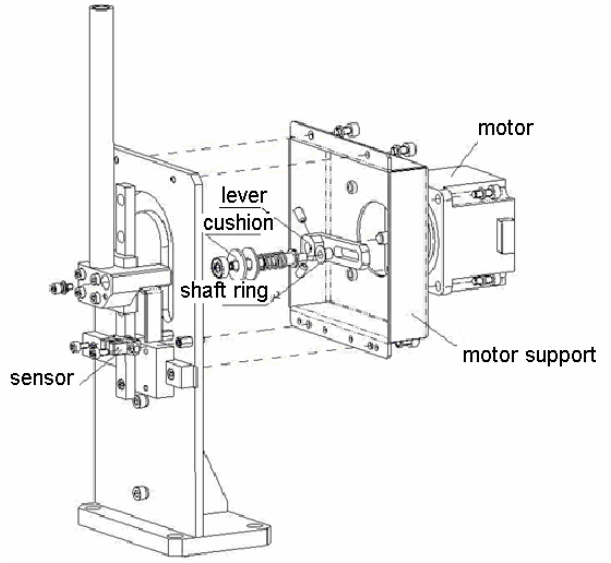
1. Remove the mixing bar by loosening the nut.
2. The mixing motor is fixed on arm base with two M2x4 cross pan head screws allocated with plain pad. Remove the mixing motor by removing the cover and the two screws.

Precautions:

1. Make sure that the end of mixer is in contact with protruding plane of the mixing motor as close as possible before screwing the nut.
2. Make sure to keep the mixing bar clean while removing and installing it.
3. Remove the cables before performing above steps.

4.5.3.2 Mixer Drive Assembly

Figure 4-28 Mixing drive assembly



1. The motor is fixed on motor support with four M4x10 hexagon socket head screws allocated with spring pads. Remove the motor by loosening the four screws, and

then loosen two M4x8 hexagon socket set head screws to remove the lever from the motor.

2. Remove the motor support which is fixed to cam board by two M4x6 and two M4x8 hexagon socket head screws allocated with spring pads, and then take out the shaft ring.

3. Remove one M3x8 hexagon socket head screw allocated with spring pad and plain pad, and then take out the output shaft and cushion.

4. The sensor is fixed to bolt by two M3x6 hexagon socket head screws; remove the sensor by loosening the two screws.

Precautions:

1. The motor shaft should protrude the plane of lever about 3mm while installing the lever.

2. Place the plug of stepping motor faced down while installing the stepper motor.

3. Remove the cables before performing above steps.

4.6 Photometric Unit

4.6.1 Introduction

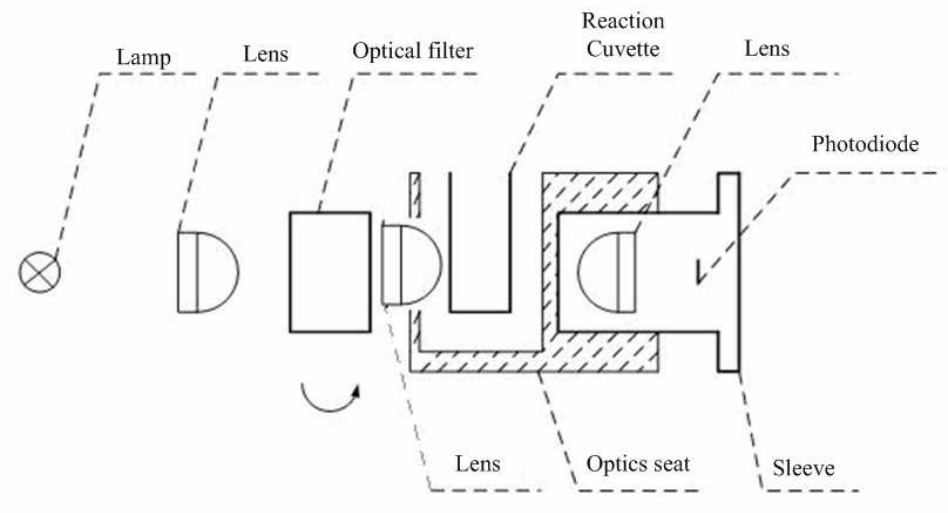
Chemistry analyzer is a typical instrument which features in optics，mechanics, electronics and arithmetic. The photometer is one of the key components of the instrument and determines directly the precision and accuracy of measurement of the system.

The light source irradiates directly the cuvette in the photometer. A combined light passes through an optical interference filter and turns to a monochromatic light. The monochromatic light passes through the cuvette and is received by the photoelectric detector and then is converted into an electrical signal by the photoelectric detector. The microprocessor calculates the concertration of the solution in the cuvette by contrasting the optical intension of the light before and after passing through the solution. The multiple monochromatic wavelengths in the pototometer system are obtained by utilizing the filter wheel. Rotate the filter of a specific wavelength to the light path while performing the colormetric measurement.

4.6.2 Components of Photometric Unit

The lens 1 converges the light beam emitted from the light source to the filter. The lens 2 collimates the monochromatic light beam aimming to the reaction cuvette. The light is absorbed when passing through the solluton and then is converged at the photodiode via the lens 3. Finally the photodiode converts the light signals into electric signals and then outputs them. From the outside to the inside of the reaction disk, the whole configuration of the light path is shown in Figure 4-29.

Figure 4-29 Structure of Photometric Unit



The photometric unit is installed on the reacton disk (see Figure 4-22). It can be divided into two parts (see Figure 4-30): Light source assembly and Forward optics assembly.

The AD collection board that performs data collection is placed in the AD housing assembly. The AD housing position on the analyzer is shown in Figure 4-31.

Figure 4-30 Components of Photometric Unit

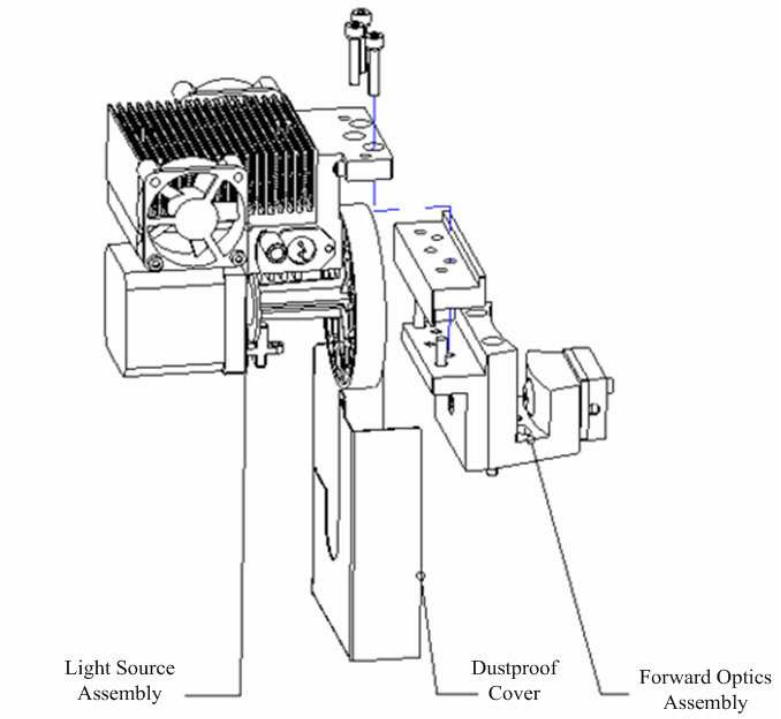
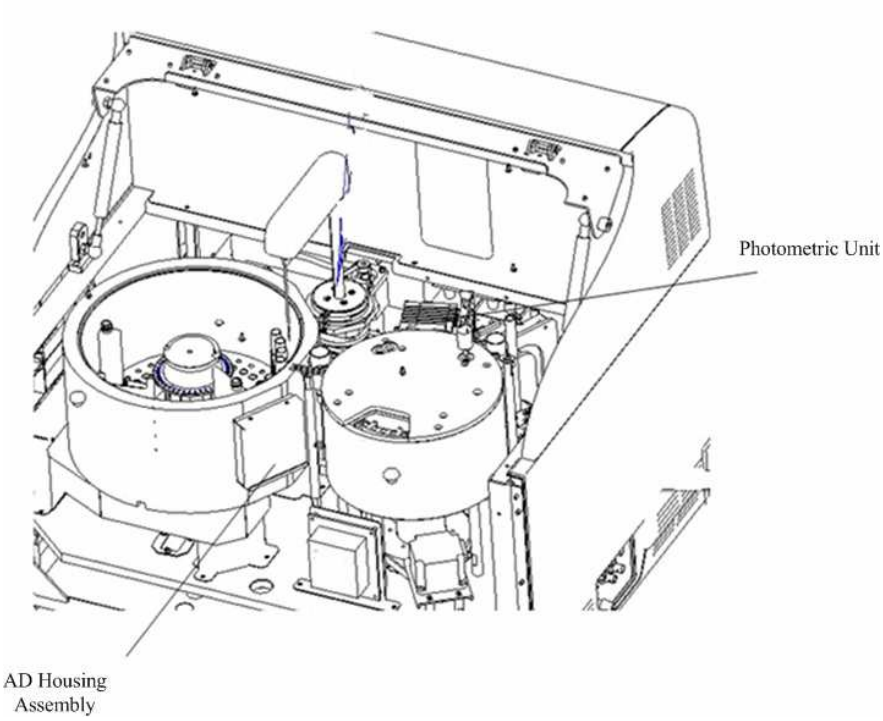


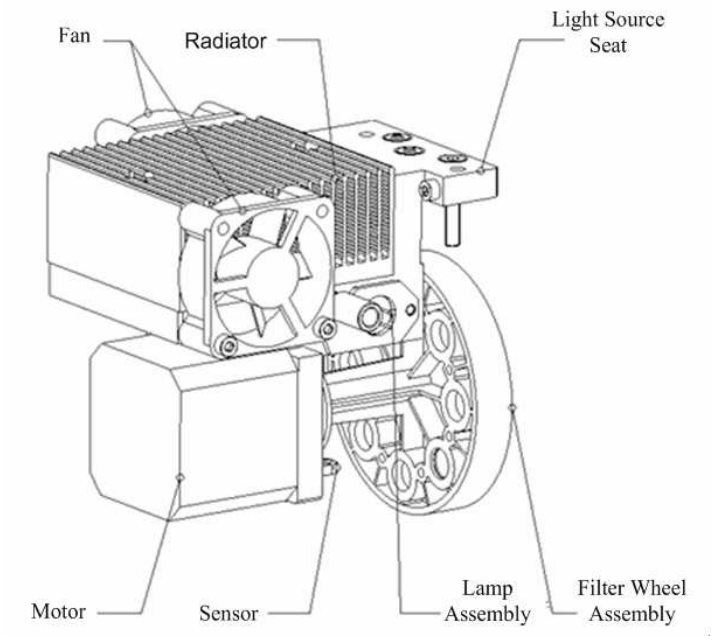
Figure 4-31 Position of Photometric Unit and AD Housing Assembly



4.6.2.1 Light Source Assembly

The light source assembly is composed of a filter wheel assembly, a lamp assembly, a light source seat, lenses, radiators, fans, a motor and a sensor. The main function is to provide a stable lignt source that emits a light beam to converge to the filter via lens. The filter of a specific wavelength is placed to the light path by rotating the filter wheel. Also a good cooling function for the lamp assembly is provided by the light source assembly.

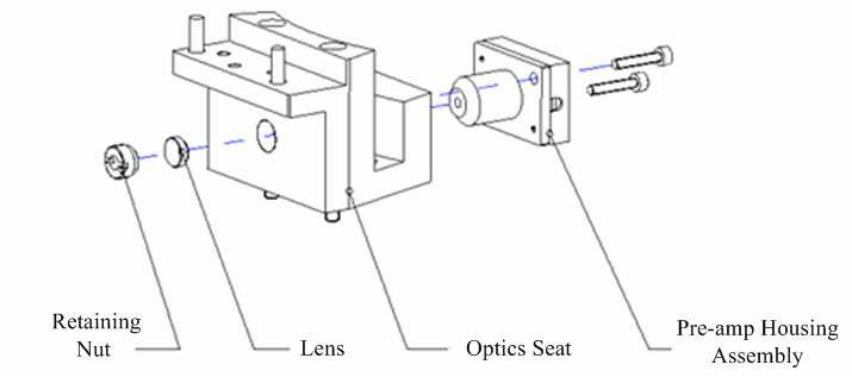
Figure 4-32 Light Source Assembly



4.6.2.2 Forward Optics Assembly

The forward optics assembly is composed of a pre-amp housing assembly, an optics seat, lenses, and a retaining nut. The main function is to converge the light beam passing through the filter at the reaction cuvette, and then to converge the light beam passing through the cuvette at the photodiode via the lens, and finally to perform the colormetric measurement.

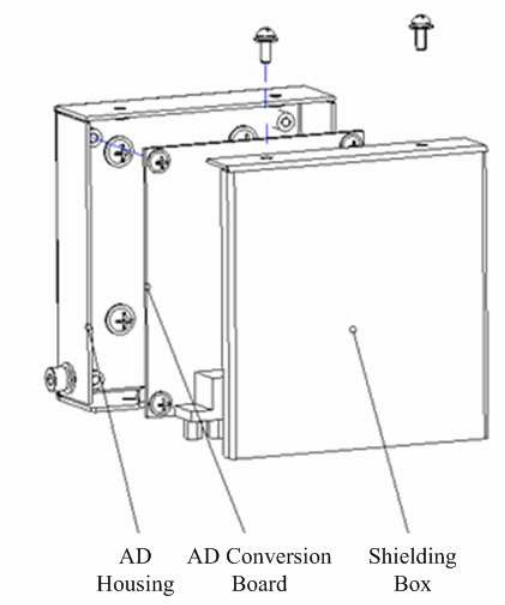
Figure 4-33 Forward Optics Assembly



4.6.2.3 AD Housing Assembly

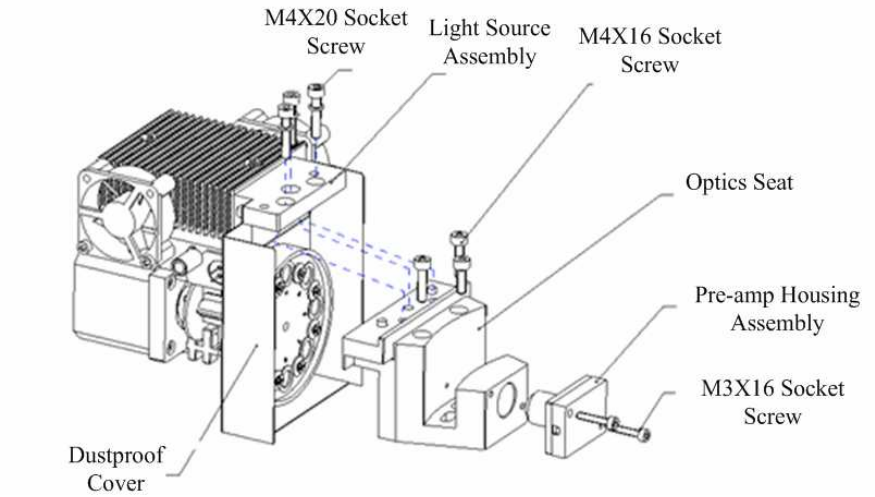
The AD housing assembly is composed of an AD housing, a shielding box and an AD conversion board. The founction of the AD housing assembly is to support and shield the AD conversion board.

Figure 4-34 AD Housing Assembly



4.6.3 Dismounting and Mounting Photometric Unit

Figure 4-35 Dismounting Photometric Unit



Dismounting steps are as follows.

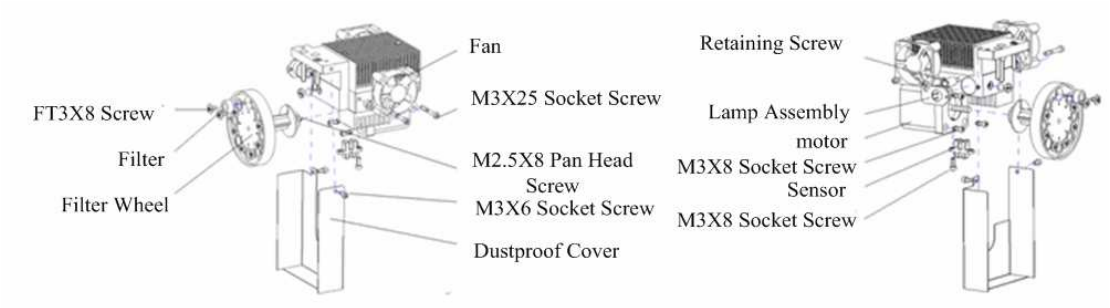
1. Remove the rear panel of the analyzer and the table panel 1 above the light source aassembly.
2. Remove the light source assembly: Loosen the three M4X20 socket screws and unplug the connectors of the lamp wire, the fan wire, the motor wire and the sensor wire. And then remove the light source assembly.
3. Remove the forward optics assembly: Remove the reaction disk cover and the reaction disk. Loosen the three M4X16 socket screws and remove the forward optics assembly.
4. Remove the pre-amp housing assembly: The pre-amp housing assembly is installed on the forward optics assembly. Unscrew the two M3X16 socket screws and remove the pre-amp housing assembly.
5. Reserve the steps described above to mounting the photometric unit
6. Dismounting and mounting the AD housing is independent on what to do with the light source assembly and the forward optics assembly.

Precautions:

1. The light source assembly should be inclined slightly to the reaction disk when removed together with the dustproof cover. Be careful not to scrape the filter.
2. You can remove the dustproof cover and then remove the light source assembly. Thus it is easier to operate.
3. The forward optics assembly is connected with the reaction disk by matching the two pins at the bottom of the optics seat with the two corresponding pin holes in the reaction disk. It may be tight when taking out the forward optics assembly due to the firm conjunction.
4. Unplug the connectors of the wire before removing the assemblies and plug the connectors after installation.
5. Be careful not to scrape the surface of the filter when removing the light source assembly.

4.6.3.1 Light Source Assembly

Figure 4-36 Dismounting Light Sourec Assembly



Dismounting steps are as follows:

1. The filter wheel is installed on the motor. Unscrew the M2.5X8 pan head screw and remove the filter wheel.
2. Loosen the FT3X8 screws to replace the filter in the filter wheel. Refers to *Chapter 7.6.3* for details about the filter replacement.
3. Loosen the M3X8 socket screw to repair or replace the sensor.
4. Loosen the two M3X25 socket screws to repair or replace the fan.
5. Loosen the retaining screw to remove or replace the lamp. Refers to *Chapter 7.6.2* for details about the filter replacement.
6. **Precautions**:

1. Gently clean the surface of the filter with ethanol-soaked defatted cotton if it is contaminated during installation
2. Don’t touch the glass surface of the lamp with hand.
3. Put on the clean white gloves when replacing the filter or the lamp.

4.6.3.2 Forward Optics Assembly

Dismount forward optics assembly is described as follows. (See Figure 4-35)

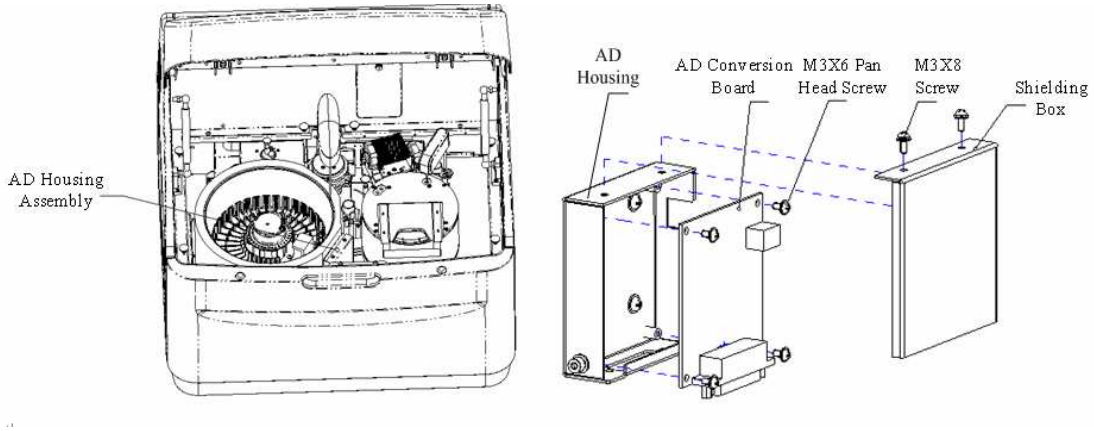
1. Remove the light source assembly.
2. Remove the reaction disk cover and the reaction disk.
3. Remove the forward optics assembly.
4. Remove the pre-amp housing assembly.
5. Reverse the steps described above to mount the forward optics assembly.

Precautions:

1. Unplug the connectors of the wire before removing the assemblies and plug the connectors after installing.Don’t touch the glass surface of the lamp.
2. Be careful not to scrape the surface of the filter when removing the light source assembly..

4.6.3.3 AD Housing Assembly

Figure 4-37 AD Housing Assembly



1. Remove the three table panels to expose the AD housing assembly.
2. Unscrew the two M3X8 screws allocated with pad and remove the shielding box. And then repair the AD conversion board.
3. Unscrew the four M3X6 pan head screws and then replace the AD conversion board.

4.6.4 Adjustment of Photometer

4.6.4.1 Adjusting Photometric Position of Reaction Disk

The photoelectric collecting position in the reaction disk depends on the installing position of the coder sensor of the reaction disk. Any slight movement of the sensor will change the photoelectric collecting position and then affect the performance of photoelectric collection. Therefore, don't remove the coder sensor unless it is necessary.

CAUTION

Don't remove the coder sensor of the reaction disk unless it is necessary.

It is necessary to check the photoelectric collecting position after replacing the the coder sensor or tightening the screw of the sensor bracket,

The adjustment of photometric position is carried out by using an oscillograph to measure the photoelectric analog signal and the AD collection start signal. The probe of the oscillograph should be connected to the specified signal test point.

The adjusting steps are described as follows.

1. Make sure to turn off the power switch of the analyzing unit.
2. Open three table panels to expose the AD housing assembly. (See Figure 4-37)

CAUTION

Before opening the table panels, pull up the sample probe and the mixing bar so as to operate conveniently.

WARNING

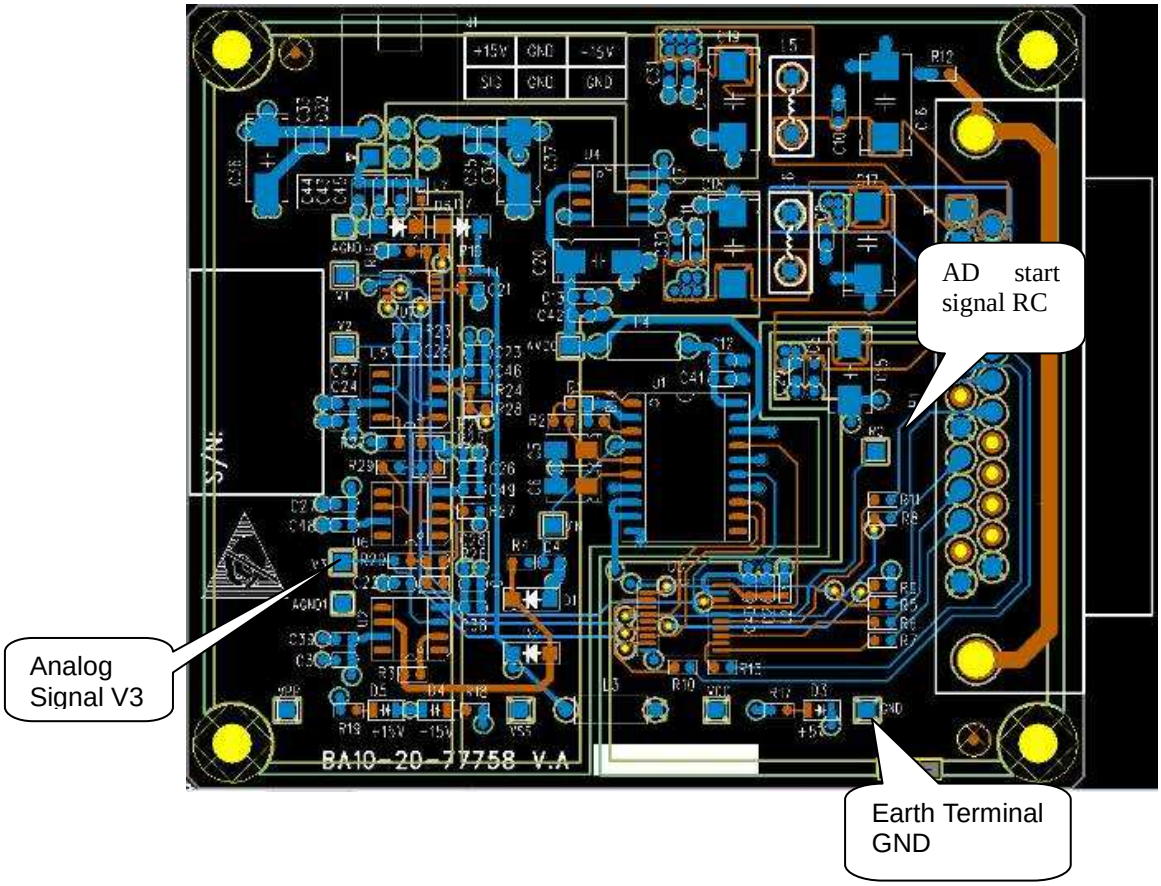
Be careful not to be injured by the sample probe.

BIOHAZARD

Don't touch the the sample probe with naked hand.

3. Open the shielding box of the AD housing assembly(See Chapter 4.6.3.3), and connect two probes of the oscillograph to the AD start signal(RC and GND) and the analog signal (V3), then connect the earth terminal to the ground.

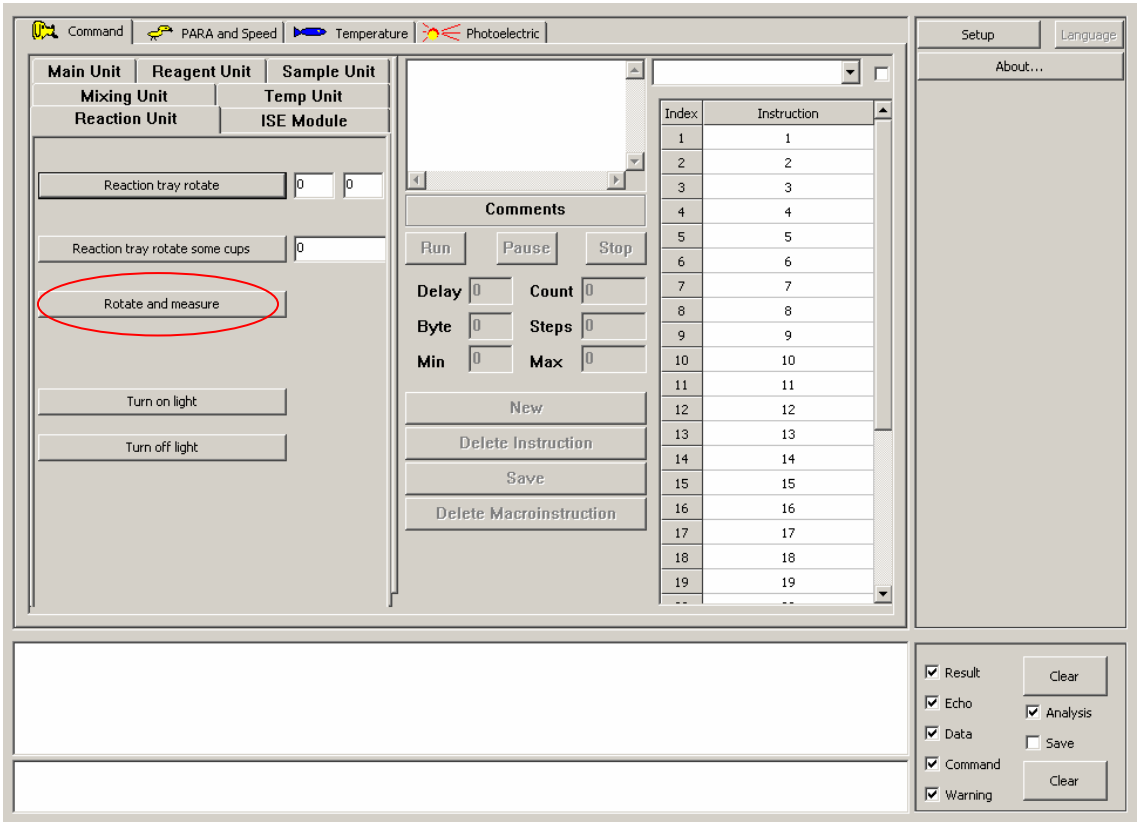
Figure 4-38 AD Conversion Board



4. Turn on the Main Power.

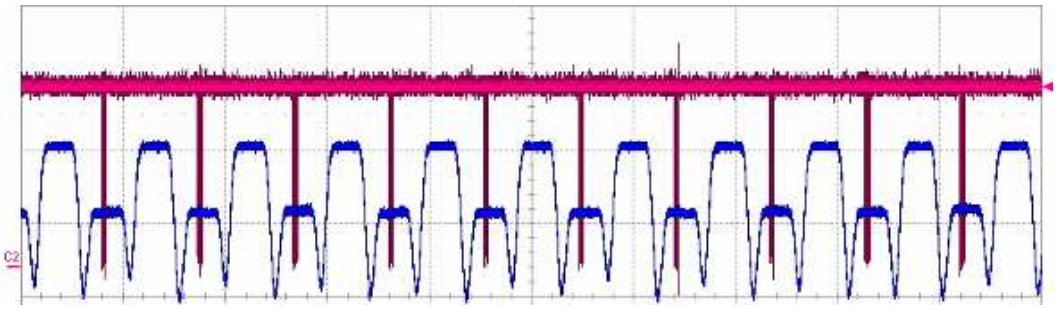
5. Enter the BS-120/BS-130/BS-180/BS-190 test and maintenance software(See Chapter 8). Place 40 clean cuvettes on the reaction disk. Click ***Rotate and measure*** to start the photoelectric measurement. In the meantime, start the signal collection of the oscillograph. The software interface is indicated in Figure 4-39.

Figure 4-39 Photometric Instruction



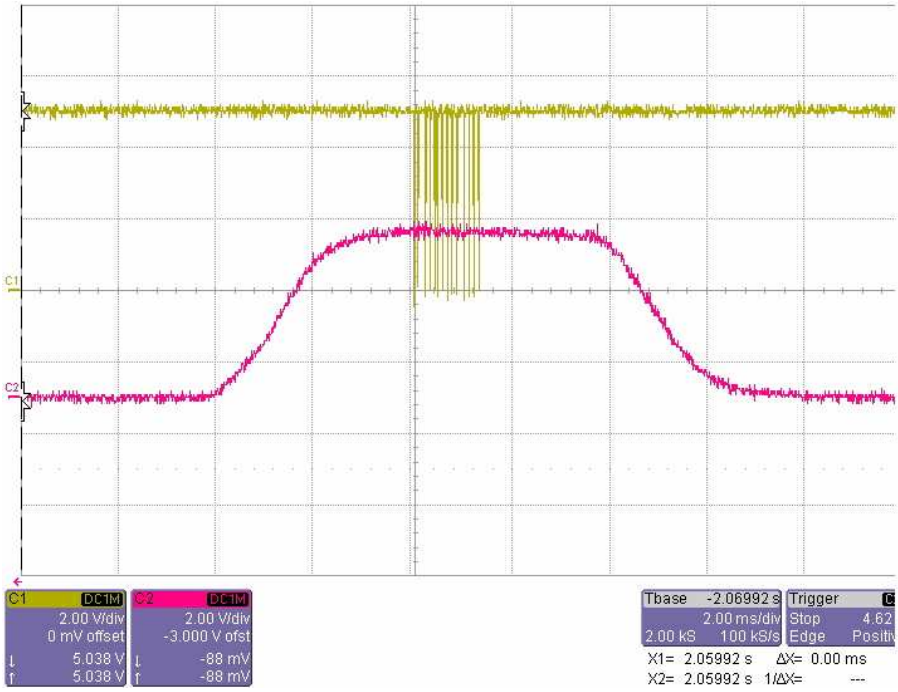
6. When the oscillograph displays the complete waves circularly shown in Figure 4-40, press ***STOP*** on the oscillograph. The waves are frozen.

Figure 4-40 Photometric Wave



7. Magnify the waves shown above and check whether the AD start signal is in the middle of the photometric analog signal (See Figure 4-41). If yes, the photometric position is correct.

Figure 4-41 Photometric Wave Feature

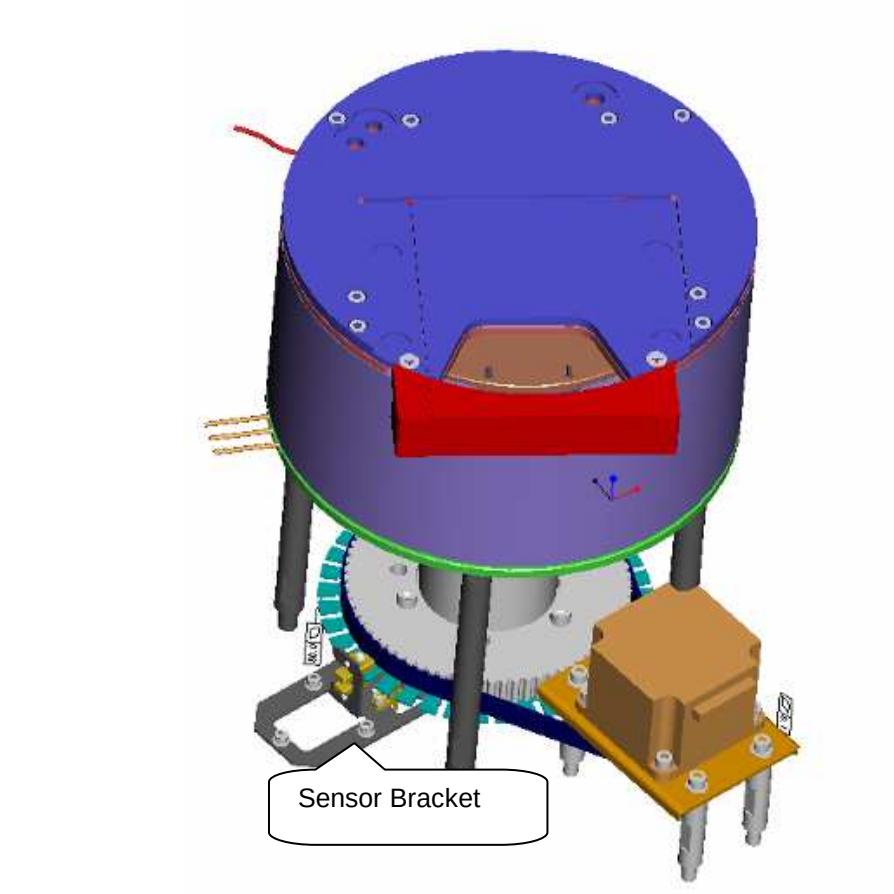


8. If the AD start signal is in the decreasing part of the photometric analog signal instead of the middle part, the photometric position is not proper and must be adjusted by moving the coder sensor of the reaction disk. If the AD start signal is on the left, then move the sensor along clockwise. If it is on the right, move the sensor along counter-clockwise. The left panels, right panels and front panels should be removed for adjusting the sensor.

10. Adjust the coder sensor of the reaction disk: the sensor is fixed on the sensor bracket and only the sensor bracket should be adjusted.See Figure 4-42, loosen the three screws and adjust the sensor bracket position according to the photoelectric wave. After completing the photometric position adjustment, tighten the three screws.

11. After finishing the above operation, send ***Ordinary Rotate&Measure Instruction*** and check the photometric waves again.

Figure 4-42 Adjusting Coder Sensor of Reaction Disk



4.6.4.2 Adjusting Offset of Filter Wheel

After moving the sensor of the filter wheel or removing the filter wheel, you should adjust the offset of the filter wheel and set parameters.

Refer to *Chapter 8.5.1* for details about adjusting the filter wheel offset.

4.6.4.3 Adjusting Signal Gain of Photometric Unit

The purpose of adjusting signal gain is to ensure that the air blank AD value is within 48000 -60000 after replacing new lamp.

CAUTION

If air blank AD value is lower than usual after replacing new lamp, check whether the surface of the lamp or the filter is dirty.

Refer to *Chapter 8.5.2* for details about adjusting signal gain of the photoelectric unit.

Precaution for signal gain adjustment：

1. It is not recommended to extend the service life of the lamp by adjusting the signal gain.

2. The signal gain of the photoelectric unit has been configured properly before the analyzer is sold to the custumer. When an alarm occurs indicating weak light, replace the lamp directly instead of adjusting the signal gain. Usually it is unnecessary to adjust signal gain after replacing the lamp. However, after doing that, you should check whether the air blank AD exceeds the range on the Maintenance-***Daily Maint.*** page of the operating software. If not, click ***new lamp*** to complete replacing new lamp. If yes, you need to adjust the signal gain.

3. Adjust the signal gain: It is recommended to use both automatic adjustment and manual adjustment. Adjust signal gain automatically, and then adjust manually.

4.6.4.4 Checking Performance of Photometer

It is recommended to check the performance of photometer under the following conditions:

1. The analyzer installation is completed.

2. The lamp is replaced or re-installed.

3. The filters are replaced or re-installed.

4. The measurement data is abnormal.

The checking method is as follows.

Request the tests that use water as sample and reagent in operating software.

For replacing or re-installing the lamp, request 20 times replicated tests in which the test wavelength parameter is set as 340 and 405nm.

For other cases, it is necessary to check performance of each walvlength. So request 5 times replicated tests under each diffirent wavelength respectively (40 tests total).

The test time is set as 0~35 and other parameters are not limited.

Check reaction curve and data of each test after completing all the tests. The difference between the minimum absorbance value and the maximum value for each detecting point should be less than 30.

If the results can't be compliant with the requirement, please check the following details.

- If the test data from all wavelengths are abnormal, make sure that the installaion of lamp is ok, including whether the pottery socket is stable and whether the lamp is installed in the proper position.

- If the test data from a part of wavelengths are abnormal, check whether the filter is installed in the right way or whether the filter surface is dirty or has nicks

- Check whether the lamp intensity is stable.

- If the test data from a few cuvettes can't be compliant with the requirement, it can be concluded that there is no problem with the photometer and then check whether there are air bubbles in the cuvette or whether the surface of the cuvette is dirty. If yes, the photomethic performance is ok and the abnormal data can be ignored.

Check the performance again after resolving all of the above problems. If there are still abnormal data, please contact the development engineer.

4.7 Power Supply Unit

4.7.1 Function and Components

The power supply unit provides the proper power for each module of the analyzer. It consists of three PCB boards, four fans, power switch and plug receptacle.

- The power system includes three circuit boards: 24V board, 12V board and power connection board.
- The 24V board transforms the AC power to the A24V, B24V and A12V the lamp source).
- The 12V board transforms the AC power to other 12V(B12V and C12V) and 5V required by the system.
- The power connection board has the function of relaying the AC power, transforming the voltage to -12V, controlling the C12V and relaying the output of the other voltages.
- The power supply unit provides all power through the joggles on the power connection board, but the 24V board and the 12V board connect the power connection board through the board to board plugs.
- The power supply unit is an integrated module. It can be shielded and isolated by the metallic crust.
- The heat radiation of the system is implemented via the cooling air provided by fans.

4.7.2 Dismounting Power Supply Unit

The position of power supply unit is shown as Figure 4-43.

Figure 4-43 Position of Power Supply Unit

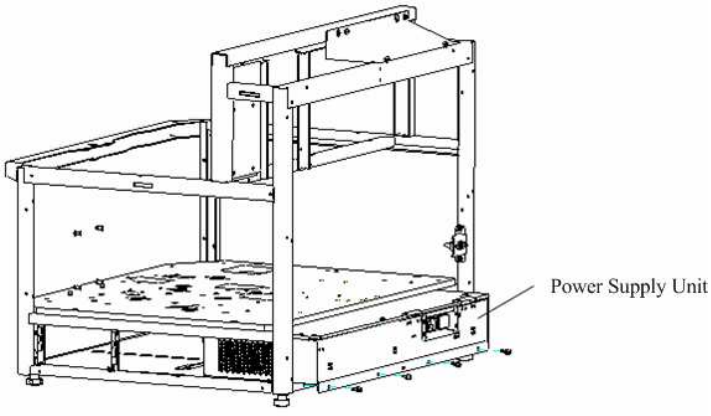
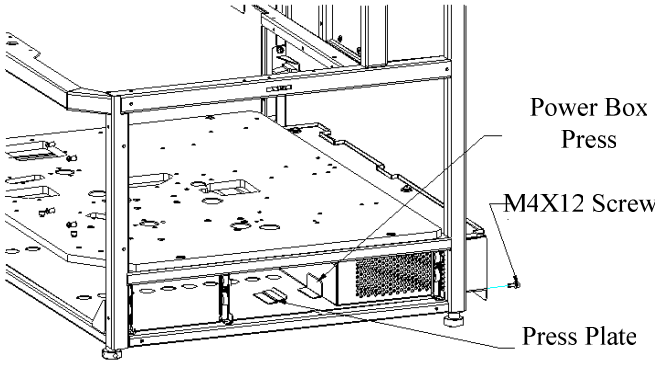


Figure 4-44 Dismounting Power Supply Unit



The dismounting steps are shown as follows.

1. Remove the rear panel.
2. Unplug all connection cables.
3. Remove the four M4x12 cross pan head screws and then pull out the power supply module from the framework.

The mouting steps are shown as follows.

1. Push the power supply module into the framework and insert the power box press under the press plate.
2. Fix the power supply module using four M4x12 cross pan head screws.
3. Install the rear panel.
4. Plug all connection cables.

4.8 ISE Unit (Optional)

4.8.1 Introduction

The ISE module is optional for fully-automated chemistry analyzers and designed to measure the concentration of K+, Na+, Cl- and Li+ in serum, plasma and diluted urine. The volume needed for testing is 70µl in the serum or plasma sample and is 140µl in the diluted urine sample. The dilution ratio of the urine sample is 1:10 (1 part of urine sample and 9 parts of diluent)

4.8.2 Components of ISE Unit

The ISE unit consists of the ISE module, pump module and reagent module. See Table 4-1 and Figure 4-45.

Table 4-1 Components of ISE Unit

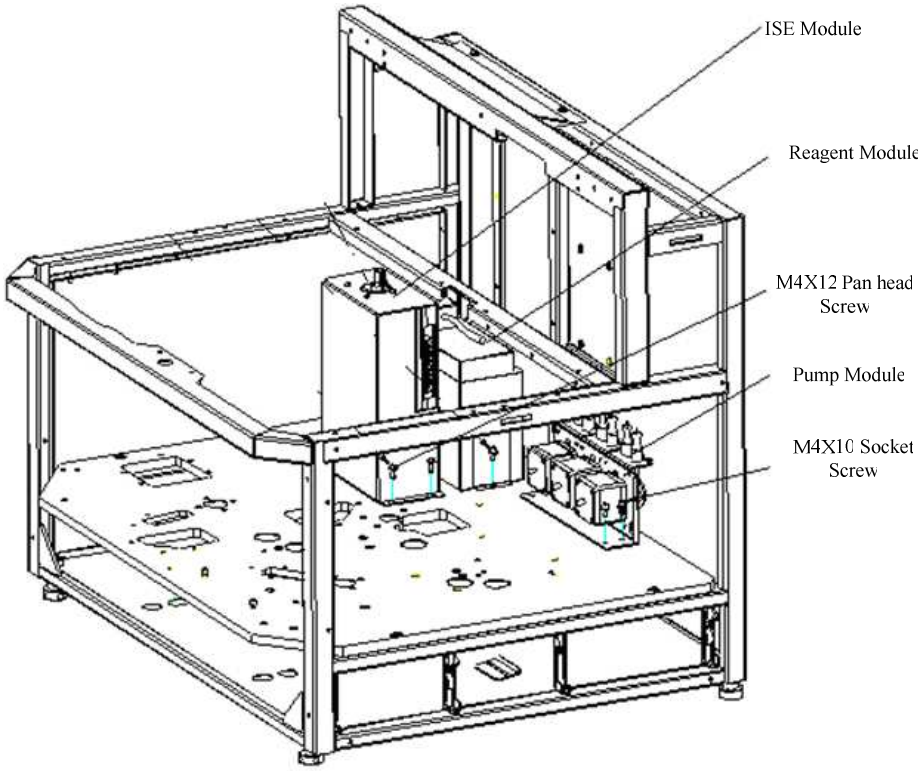
NAME	DESCRIPTION
ISE module	The ISE module includes five electrodes (Li+, Na+, K+, Cl- and Reference). Samples are dispensed via the sample entry port on the top of the ISE module and then measured.

Pump module	The pump module includes three peristaltic pumps, which are used to transfer reagents and waste liquid.
Reagent module	The reagent module includes calibrant A, calibrant B, waste tank and a chip that indicates the remaining volume of the reagent. This module provides the function of the reagents supply and the waste liquid storage.

4.8.3 Installling and Removing ISE Unit

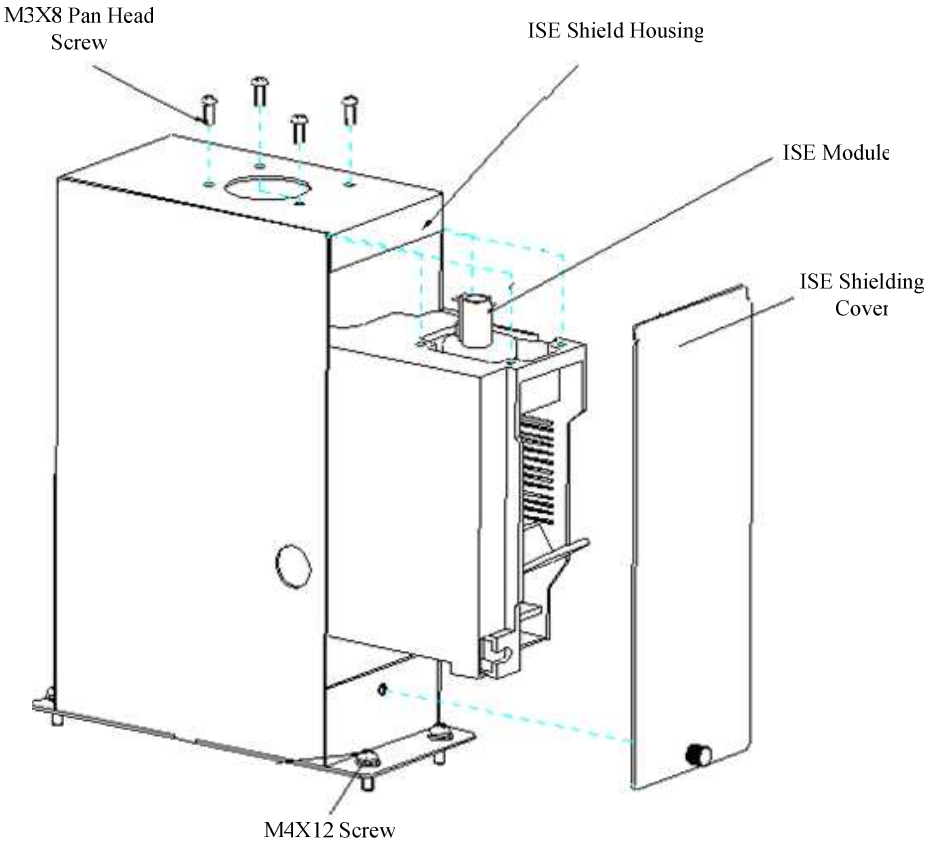
The ISE module, pump module and reagent module are fixed on the base board with screws. (See Figure 4-45)

Figure 4-45 Components of ISE Unit



4.8.3.1 ISE Module

Figure 4-46 ISE Module



The dismounting/mounting steps are as follows (see Figure 4-46).

Dismounting steps:

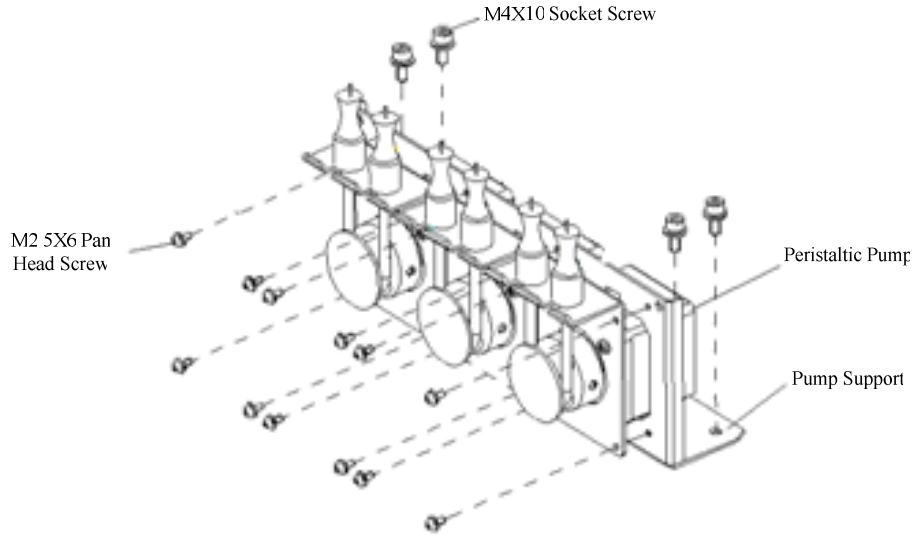
1. Remove the table panel and the ISE unit door.
2. Unplug the draining tube connected to the ISE module.
3. Loosen the screw and remove the ISE shielding cover.
4. Loosen the four M3X8 cross pan head screws retained on the ISE shield housing and remove the ISE module.

Mounting steps:

1. Install the ISE module on the ISE shield housing by tightening the four M3X8 cross pan head screws.
2. Install the ISE shielding cover by tightening the screw.
3. Pull out the draining tube through the hole in the ISE shielding cover.(it is not indicated in figure)
4. Install the table panel and ISE unit door.

4.8.3.2 Pump Module

Figure 4-47 Pump Module



The dismounting/mounting steps are as follows. (See Figure 4-47)

Dismounting Steps:

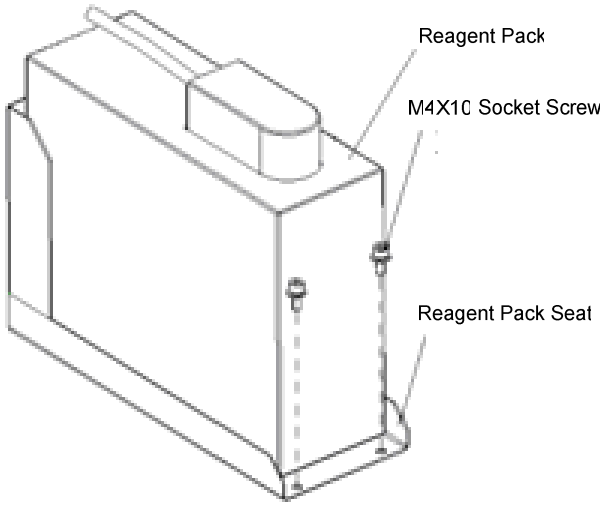
1. Remove the rear panel of the analyzer.
2. Pull out the tube and unplug the connection of the motor. (not indicated in figure.)
3. Loosen the four M2.5X6 screws and remove the peristaltic pump. The installation of the three pumps is indepent to each other.
4. The pump support is fixed on the base board by tightening the four M4X10 socket screws. Remove the pump support if necessary.

Mounting steps:

1. Fix the pump support on the base board by tightening the four M4X10 socket screws.
2. Install the peristaltic pump on the pump support by tightening the four M2.5X6 cross pan head screws.
3. Connect the tube and plug the connection of the motor.
4. Install the rear panel on the analyzer.

4.8.3.3 Reagent Module

Figure 4-48 Reagent Module



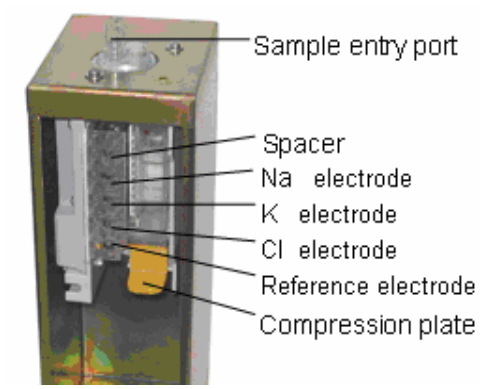
The reagent module consists of a reagent pack and a reagent pack seat. The reagent pack seat is fixed on the base board by the three M4X10 socket screws.

Dismounting steps:

1. Remove the ISE unit door on the left side of the analyzer.
2. Pull out the tube of the reagent module.
3. Take out the reagent pack horizontally.

4.8.3.4 ISE Electrodes

The steps of installing the ISE Electrodes are as follows.

1	Take out the reference electrode from the package and pull out the yellow intubatton. Pull down the press plate of the ISE module and push the reference electrode into the ISE module. (Don't throw away the yellow intubatton and use it again when storing the electrode.) If white crystalloids adhere to the tube of the reference electrode, wash it with warm water before installing.
2	Put the other electrodes into the ISE module. It is easier to install the K+, Na+, Cl- electrodes than the spacer electrode. To insert the spacer electrode (the top one), it is needed to slightly press the press board.  Caution: Replace the space electrode with the Li+ electrode when necessary.

3	Check whether the five electrodes are installed properly.Make sure the electrodes stand in a line vertically and their front surfaces are lined up.

Remove the electrodes following the reverse steps described above. It is important to execute the procedure such as tubing purge and warm-up before dismounting the electrodes. Store the electrodes properly after removing them from the instrument. Refer to *Chapter 7.7.4* for more details about removing and storing the electrodes.

CAUTION

The ISE unit (optional) should be on power all the time. In some cases the Power will be shut down for more than half an hour, strore the electrodes referring to *Chapter 7.7.4.*

5 Fluid System

5.1 Main Functions

1. To achieve an accurate and reliable sampling performance through the syringe and the probe;

2. To completely wash the inside and outside of the probe.

3. To completely wash the mixing bar;

4. To drain the liquid waste generated from reagent refrigerating system;

5. To provide the washing solutions and collect liquid waste.

5.2 Functional Structure

The fluid system mainly consists of sampling system and washing system. The sampling system consists of syringe module and probe module; the washing system consists of pump/valve module and wash-well module. The functional structure of the fluid system is shown in Figure 5-1. The functions of individual module are listed as below:

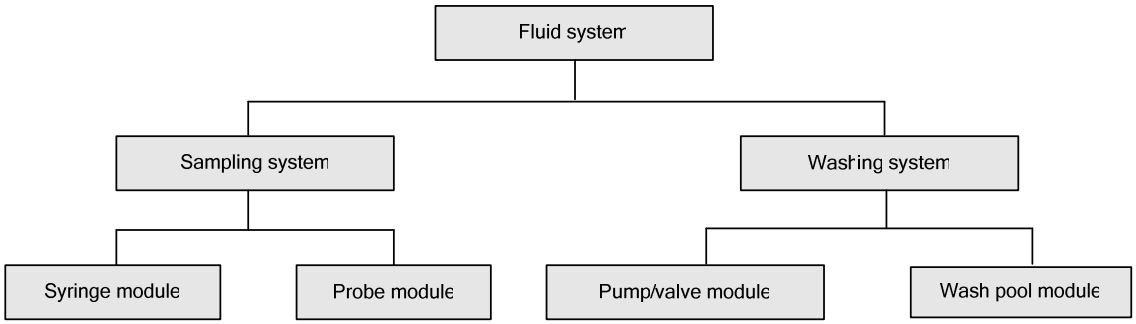
1. Syringe module: drive the transportation of the reagent or sample and assure the precision of the sampling of reagent/sample.

2. Probe module; A single probe is used to aspirate and dispense the reagent and sample in the fluid system.

3. Pump/valve module: supply water to wash the inside and outside of the probe and the mixing bar in a specified mode. The assembly consists of the interior pump, exterior pump, solenoid valve and restrictor ring.

4. Wash-pool module: consists of two same wells, to wash the probe and the mixing bar correspondingly.

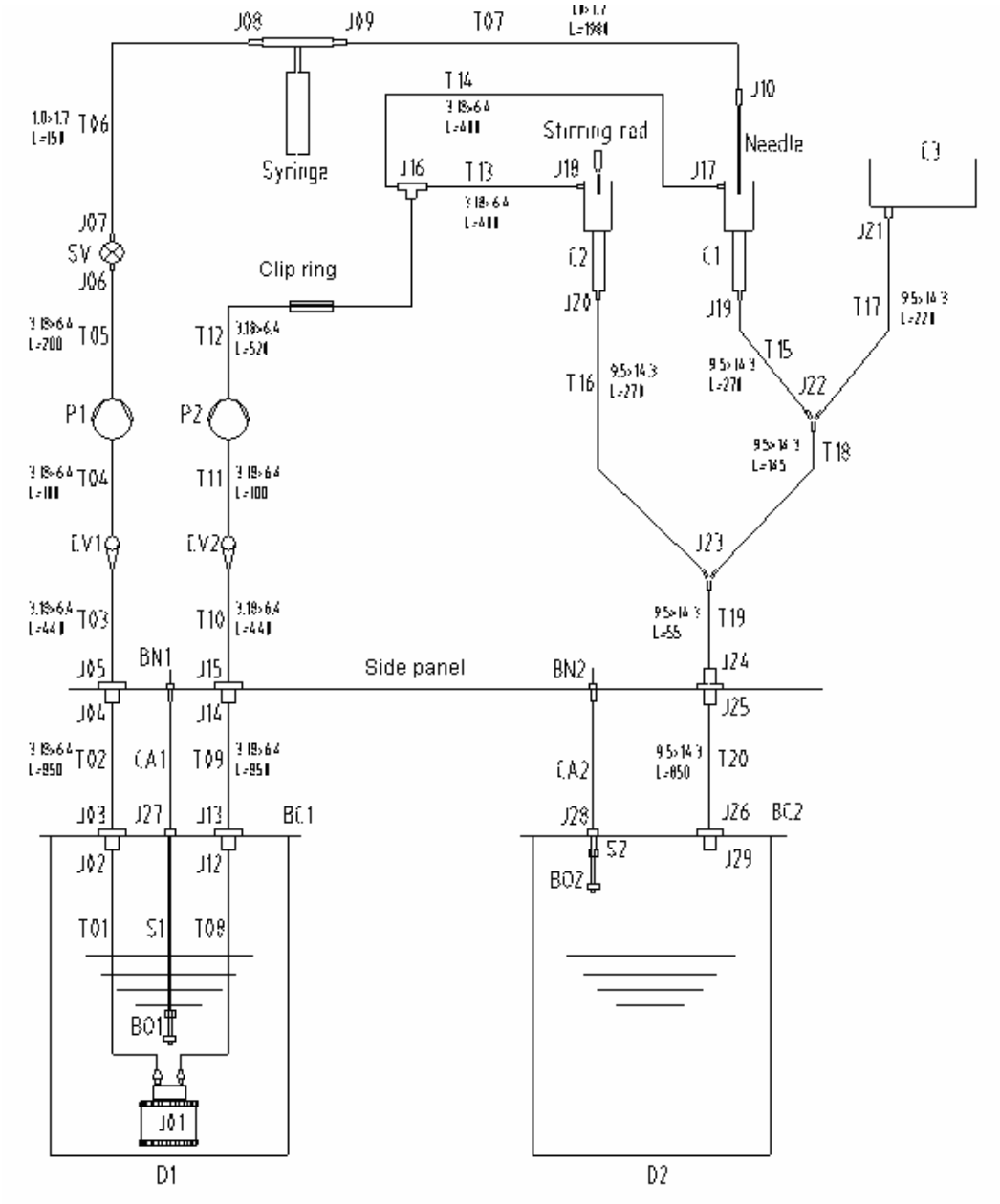
Figure 5-1 Functional Structure of Fluid System



5.3 Fluid System Chart

The fluid system mainly consists of syringe, probe, pump, solenoid valve, deionized water tank, waste tank, filter, tubing and the corresponding connectors. The schematic diagram of fluid system is shown in Figure 5-2.

Figure 5-2 Schematic Diagram of Fluid System



5.4 Major Components and Their Functions

Table 5-1 Major Components List

NO.	Name	Material code	Model	Quantity	Remarks
1	Check valve	M6Y-020003	AP19DB0012SN	2	1/8''
2	Deionized water tank	BA31-10-56791	Quadrate plastic tank, 10 liter, white, no cap	1	To hold deionized water
3	Waste tank	BA31-10-56791	Quadrate plastic tank, 10 liter, white, no cap	1	To hold waste

NO.	Name	Material code	Model	Quantity	Remarks
4	Syringe	BA30-10-06651	Kloehn17595	1	500ul reagent syringe
5	Interior pump	0040-10-32313	PML4962-NF30	1	350ml/min，1.5bar
6	Exterior pump	0040-10-32313	PML4962-NF30	1	350ml/min，1.5bar
7	Probe	BA40-30-61525	/	1	
8	Solenoid Valve	0040-10-32300	IEE LFVA1230213H	1	
9	Wash pool module	BA10-20-77752		2	Self made
10	Filter assembly	BA31-30-41412		1	Self made

The function of each component is described as below:

1. Check valve (CV): To prevent the deionized water in the tubing from flowing back;

2. Deionized water tank (D1): To provide the clean water for washing the probe and the mixing bar;

3. Waste tank (D2); To collect the liquid waste which is generated during the operation;

4. Syringe: To accurately deliver the reagent or sample;

5. Interior pump (P1): To provide clean water for washing the inside of the probe;

6. Exterior pump (P2): To provide clean water for washing the outside of the probe;

7. Probe (Needle): To sample the reagent/sample;

8. Solenoid valve (SV): To control the on/off of the pipette pipe, to shift the module between washing mode and sampling mode;

9. Wash-well assembly (C1, C2): To wash the probe and the mixing bar.

10. Filter (J01): filtrate the impurtiy in the water.

5.5 Connectors

Table 5-2 Connectors List

NO.	Connector Code	Material code	Name and description	Quantity
1	J01	BA31-30-41412	Filter assembly	1
2	J02,J05	M90-100009---	FTLB230-1	2
		M90-100050---	CCLR-3	2
		M90-100014---	LNS-3	2
3	J03,J04	M90-100025---	MTL230-1	2

NO.	Connector Code	Material code	Name and description	Quantity
		M90-100021---	MLLR-3	2
4	J12,J15	M90-100009---	FTLB230-1	2
		M90-100051---	CCLR-4	2
		M90-100015---	LNS-4	2
5	J13,J14	M90-100025---	MTL230-1	2
		M90-100022---	MLLR-4	2
6	J06	BA40-20-72949	Barbed connector (pattern MR72948)	1
		0040-10-32303	14271 washer	1
7	J07，J08，J09	0040-10-32304	Upchurch P-208 flangeless fitting	3
		0040-10-32305	Upchurch P-200N flangeless ferrule for 1/16”OD tubling	3
8	J10	BA30-20-06758	Tubing retaining bolt	1
		0040-10-32306	Diba 071-153-031 STAINLESS STEEL Washer	1
9	J16	M6Q-030043---	Y230-6	1
10	J21	BA10-20-78077	Condensation tubing connector of reagent disk	1
11	J22,J23	M6Q-030095---	Y670-6	2
12	J24,J29	BA10-20-78001	Nut of waste connector	2
13	J25,J26	BA10-20-78000	Waste connector	2

5.6 Tubing

Table 5-3 General Tubing List

Tubing code	Tubing model	Material	Inner-diameter (in.)	Outer-diameter (in.)	Max. working pressure （psig/bar）	Material code
1#	AAC00028	Rubber tubing	3/8	9/16	25/1.72	M6G-020047---
2#	AAC00007	Rubber tubing	1/8	1/4	45/3.11	M90-000025---
3#	DB600-10011	PTFE	0.040	0.066	1700/117	0040-10-32301
4#	AAX02004	Rubber	3/32	5/32	40/2.76	M90-100071---

Remark: The values of Max. Working Pressure are from original manufacturer’s recommendation.

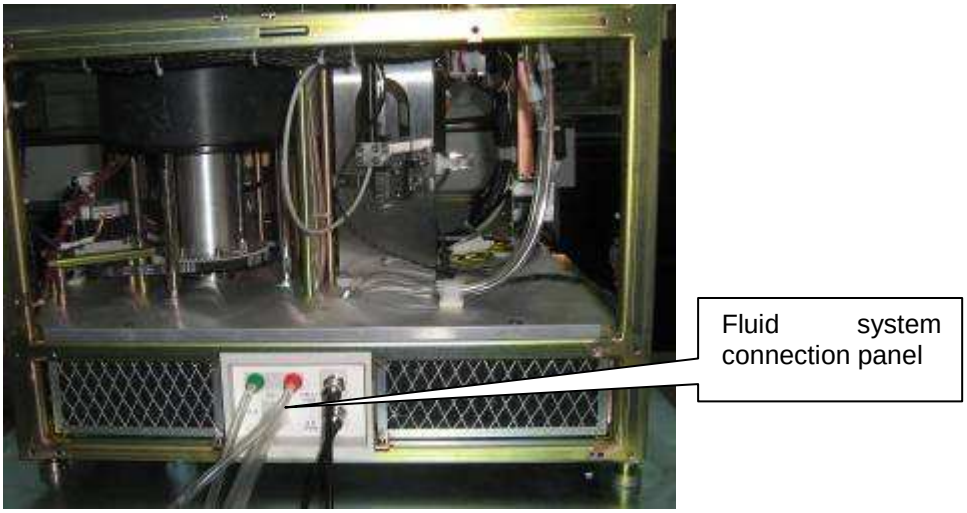
Table 5-4 Detailed Tubing List

NO.	Code	Start point	End point	Type	Length(mm)
1	T01	J01	J02	4#	270
2	T02	J03	J04	2#	850
3	T03	J05	CV1	2#	440
4	T04	CV1	P1	2#	100
5	T05	P1	J06	2#	200
6	T06	J07	J08	3#	150
7	T07	J09	J10	3#	2000
8	T08	J11	J12	2#	300
9	T09	J13	J14	2#	850
10	T10	J15	CV2	2#	440
11	T11	CV2	P2	2#	100
12	T12	P2	J16	2#	570
13	T13	J16	J18	2#	400
14	T14	J16	J17	2#	400
15	T15	J19	J22	1#	270
16	T16	J20	J23	1#	270
17	T17	J21	J22	1#	220
18	T18	J22	J23	1#	145
19	T19	J23	J24	1#	50
20	T20	J25	J26	1#	850

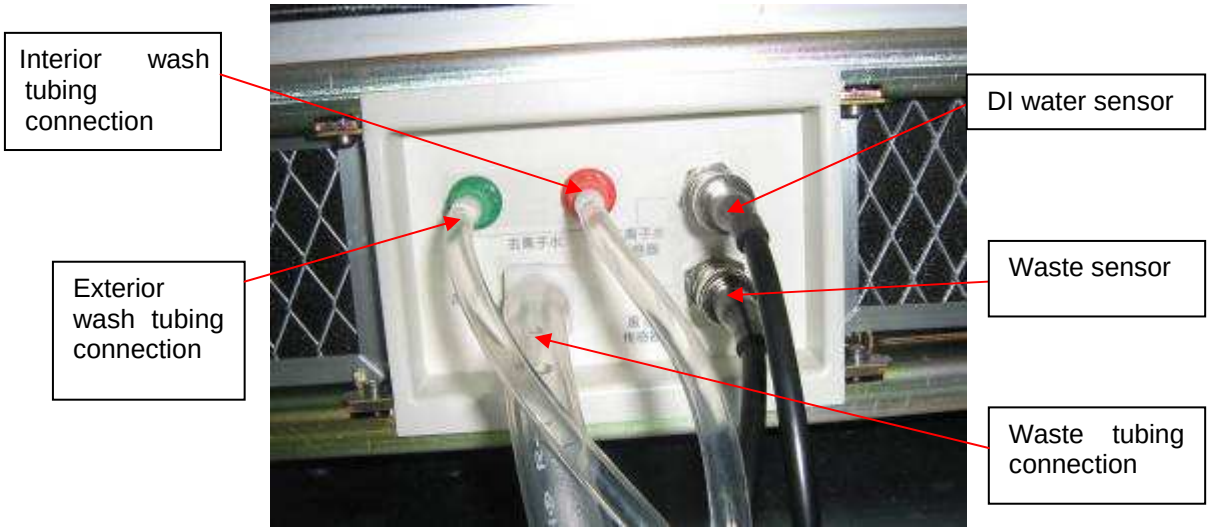
5.7 Fluid System Connections and Layout

The connections between the fluid system and the main unit and the connections among the fluid tubing are shown in Figure 5-3.

Figure 5-3 Connection between Fluid System and Main Unit



（a） Overall layout

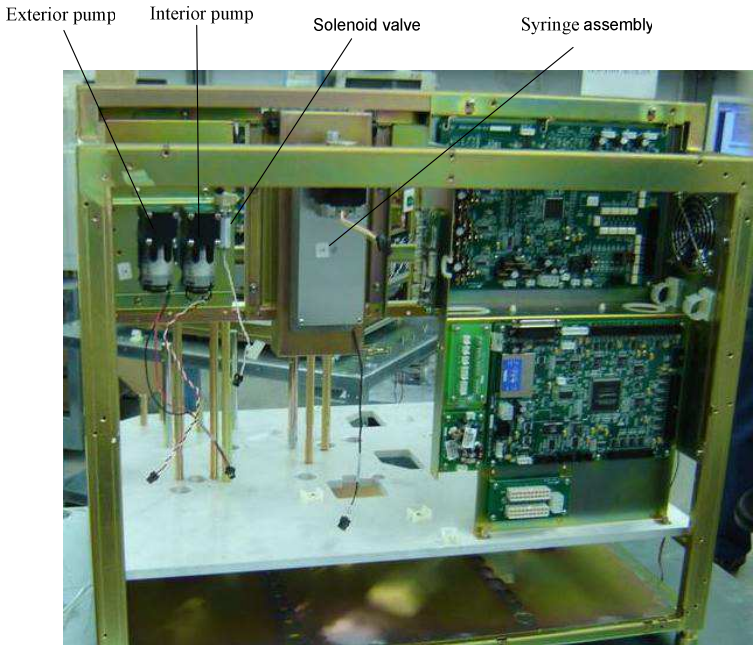


（b）Detailed connections

The DI water sensor and the wash tubing are directly connected with the DI water tank; the waste sensor and waste tubing are directly connected with the waste tank.

Within the fluid system, the positions of syringe and pump/valve assembly are shown in Figure 5-4:

Figure 5-4 Inside Assemblies' Layout



5.8 External DI Water Tank and Waste Tank

Figure 5-5 Waste Tank Connection

Figure 5-6 DI water tank connection

5.9 Key Components

5.9.1 Solenoid Valve

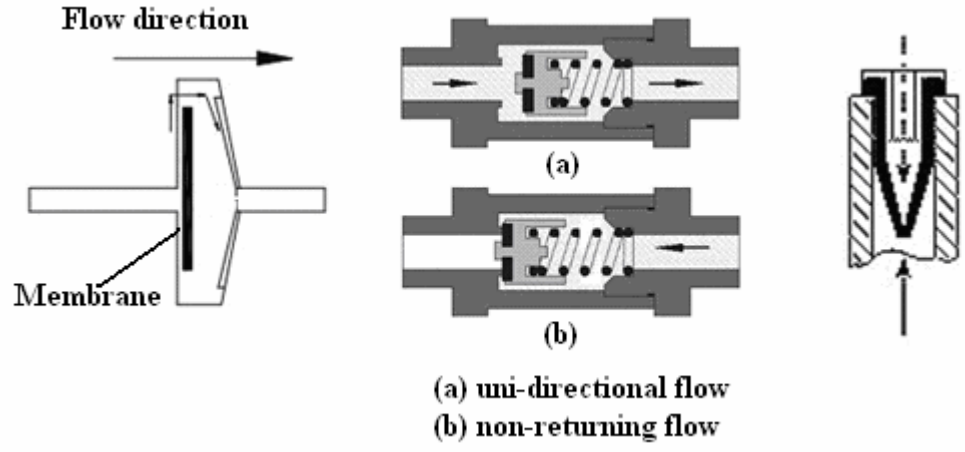
Figure 5-7 Solenoid Valve

Applied assembly: Pump/valve module

Function: To control the open/close status of the fluid pipe through its on/off switch.

5.9.2 Check Valve

Figure 5-8 Check Valve

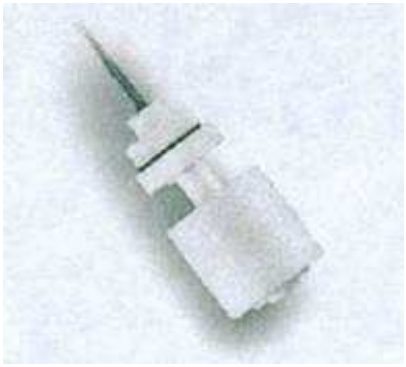


Applied assembly: Pump/valve module

Function: To assure a unidirectional flow and prevent the back-flow of the fluid in tubing.

5.9.3 Liquid Level Float

Figure 5-9 Liquid Level Float Sensor



Applied Assemblies: DI water tank and waste tank

Function: The float sensor contains a spring switch and a circular magnet inside the sealed plastic tubing. The spring switch is activated by the up-down movements of the float via the magnet and then the liquid level is detected by the system.

5.9.4 Syringe Assembly

Figure 5-10 Syringe Module

Applied assembly: sampling system.

Function: A step-motor drives the controlled spin of the screw-rod that leads to the up-down movements of the syringe in a quantitive manner. Therefore, the accurate sampling of the reagent/sample is achieved in this way.

5.9.5 Diaphragm Pump

Figure 5-11 Diaphragm pump

Applied assemblies: wash system

Function: The liquid achieves defined pressure and speed through the travel from the entrance to the exit of the diaphragm pump driven by the electronic power and then is transported into the wash wells to wash the probe and mixing bar.

5.9.6 Probe

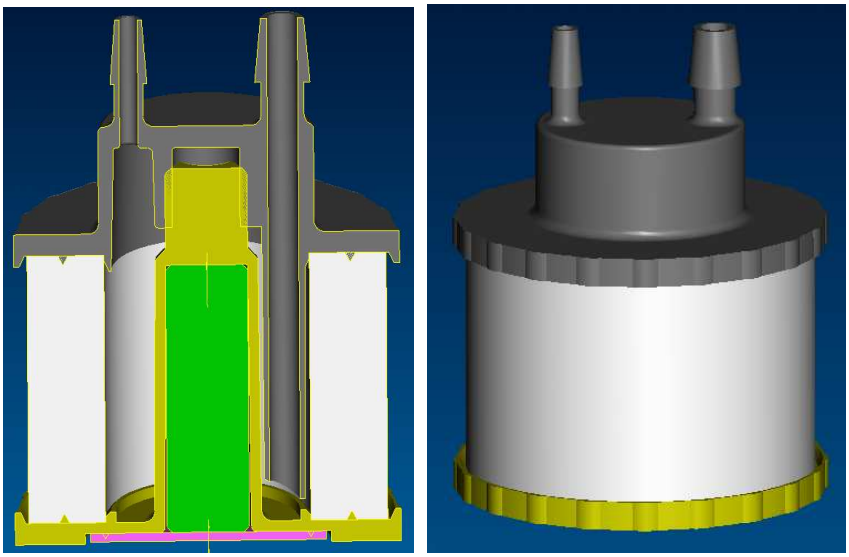
Figure 5-12 Probe (reagent/sample)

Applied assembly: sampling system

Function: Via the controlled up-and-down movements of the syringe, the probe aspirates and dispenses the reagent or sample.

5.9.7 Filter

Figure 5-13 Probe (reagent/sample)



Applied assembly: Cap assembly of the DI water

Function: Filterate the impurity in the water to avoid blockage of the pump and valve.

6 Hardware System

6.1 Overview

This chapter describes the function of circuit boards in BS-120/BS-130/ BS-180/BS-190.

6.2 Safety Precautions

WARNING

Don’t touch the circuit boards by hand or tools when the analyzer is running.

If you need to detach the circuit boards, you must first cut off the power of the analyzer.

Please wear gloves to protect the circuit boards from ESD (electrostatic discharge) or release the charge first before detaching the circuit boards.

6.3 Circuit boards

The following table lists the number and the function description of the circuit boards.

Table 6-1 Circuit Boards of BS-120/BS-130/BS-180/BS-190

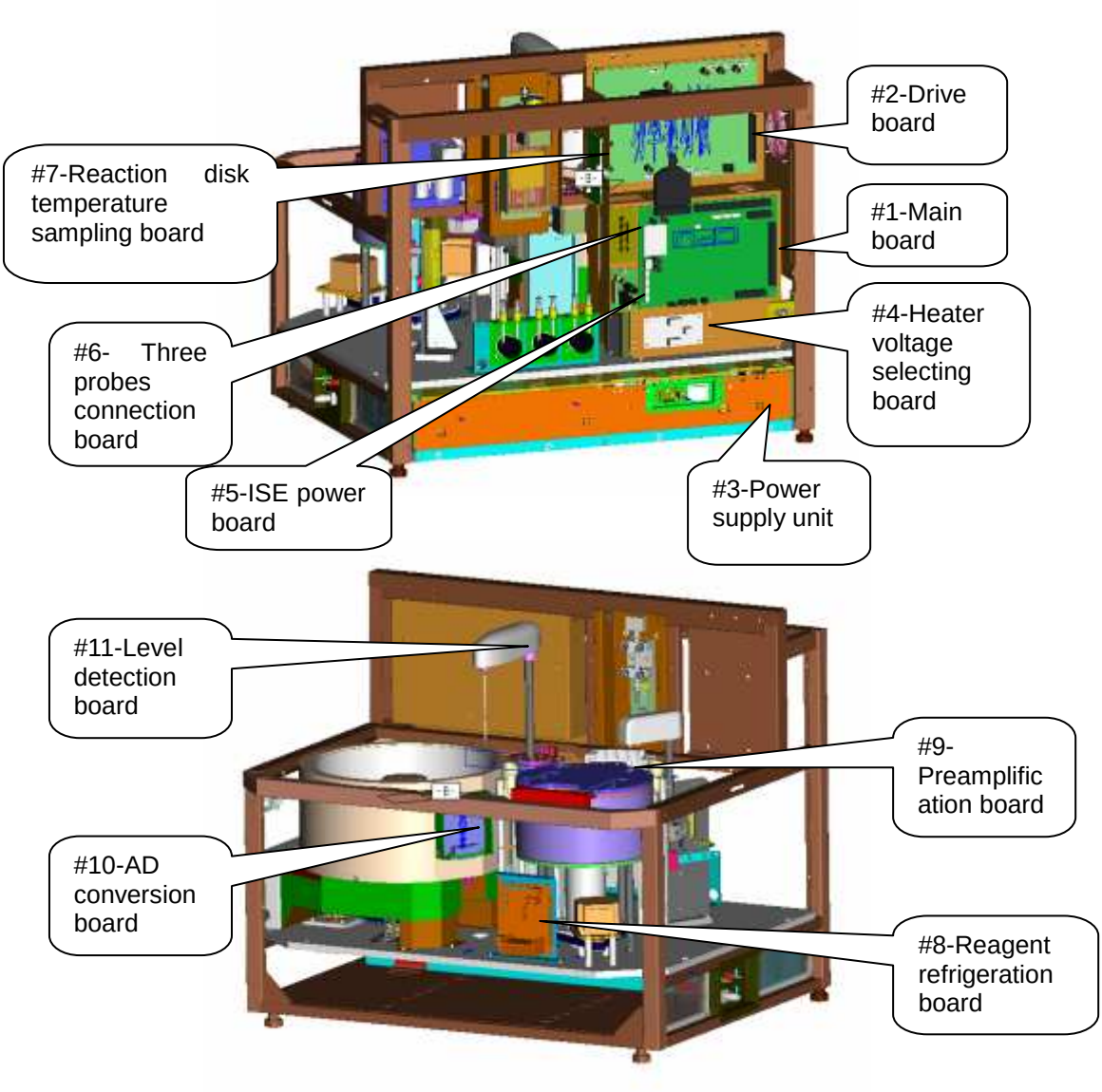
PCBA（PCB）	**Function**	**Number in Figure 6-1**
Main board BA10-30-77755 (BA10-20-77754)	As the main control part of the BS-120/BS-130/BS-180/BS-190, the main board communicates with PC through serial port RS232 and transmits data and commands; also it transmits data and commands to other sub-units (ISE, etc) through extended serial ports; This unit can control the AD conversion board to adjust the numerical control resistor and collect the photoelectric data. It can also control the reaction disk temperature sampling board to collect the temperature data.	#1
Drive board BA10-30-77757 (BA10-20-77756)	This board can control and drive the reaction disk, the reagent\sample disk, the sampling probe, the mixer, the filter wheel, the pumps, the valve, the lamp and the temperature controlling system to act.	#2
Reaction disk temperature sampling board BA10-30-78268 (BA10-20-78267)	This board collects the temperature sensor signals from the reaction disk and converts them into digital signals.	#7
Reagent refrigeration board BA20-30-75227 (BA20-20-75226)	This board is used to cool the reagents, indicate the temperature and drive the fan and defog circuit.	#8
Level detection board 051-000141-00 (050-000124-00)	This board can detect the level of the reagent or sample and detect the vertical obstructions occurring to the sampling probe.	#11
AD conversion board BA10-30-77759 (BA10-20-77758)	This board can modify the analog signals from the pre-amp board and convert the analog signals into the digital signals. Also this board provides an SPI (Serial Port Interface) for connection with the main board.	#10
Preamplification board BA10-30-77760 (BA10-20-78200)	This board can convert the light signals into the electrical analog signals by the photoelectric diode.	#9
Heater voltage selecting board	This board can provide a sutiable way to connect with the power for the reaction disk heater in different AC power environments.	#4

PCBA（PCB）	Function	Number in Figure 6-1
BA10-30-77770 (BA10-20-77769)		
Three probes connection board BA30-30-15284 (BA30-20-15285)	This board transfers the control signal of the reagent preheating, the mixer motor pulse and level detection board.	#6
ISE power board BA34-30-63624 (BA34-20-63623)	This board can supply the power to the ISE module.	#5
Power supply unit PFC board BA10-30-77764 (BA10-20-77763)	This unit supplies a stable voltage to the chemistry analyzer.	#3
24V board BA10-30-77766 (BA10-20-77765)		
12V&5V board BA10-30-77768 (BA10-20-77767)		

6.4 Layout of the Boards

Figure 6-1 shows the circuit boards on the analyzer.

Figure 6-1 Layout of the Circuit Boards



6.5 Detaching and Assembling Circuit Boards

You must pull out all plugs (refer to *Appendix A* Connection Diagram） first when you detach the boards and then loosen the fixing screws on the boards.

6.6 Function of the Boards

6.6.1 Control Framework

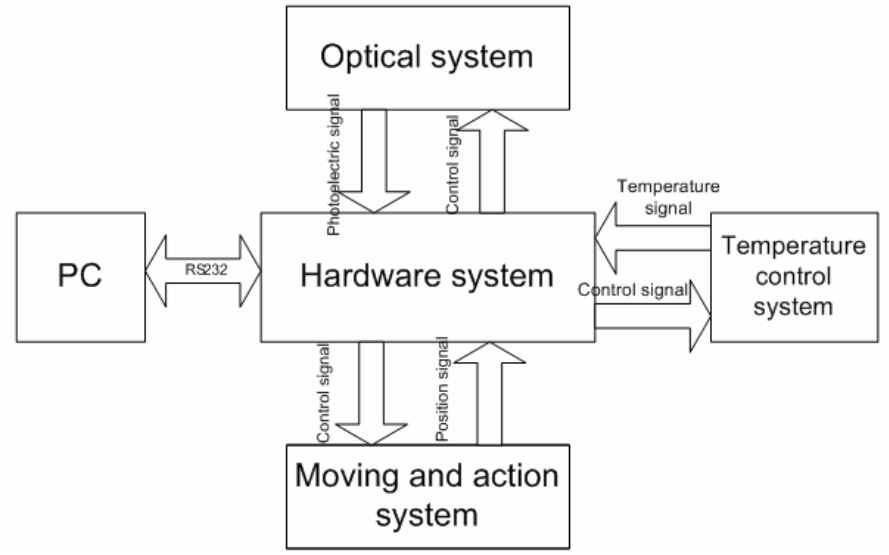
The BS-120/BS-130/BS-180/BS-190 consists of the following three units: the analyzing unit (main unit), the operation unit (PC) and the output unit (printer).

The analyzing unit (main unit) consists of the following units: the temperature control system, the reaction system (include ISE), the photometric system, the sample and reagent delivery system, the mixing system and etc.

Figure 6-2 shows the control framework of the BS-120/BS-130/BS-180/BS-190. The function of the hardware system is as follows.

- Communicating with the PC through the RS232 to send commands, reply data and test results.
- Controlling the data collecting process of optical system.
- Controlling the movement of the moving units and collecting the status signal.
- Controlling the temperature adjustment system and collecting the temperature status signal.

Figure 6-2 Control Framework



6.6.2 Main Board

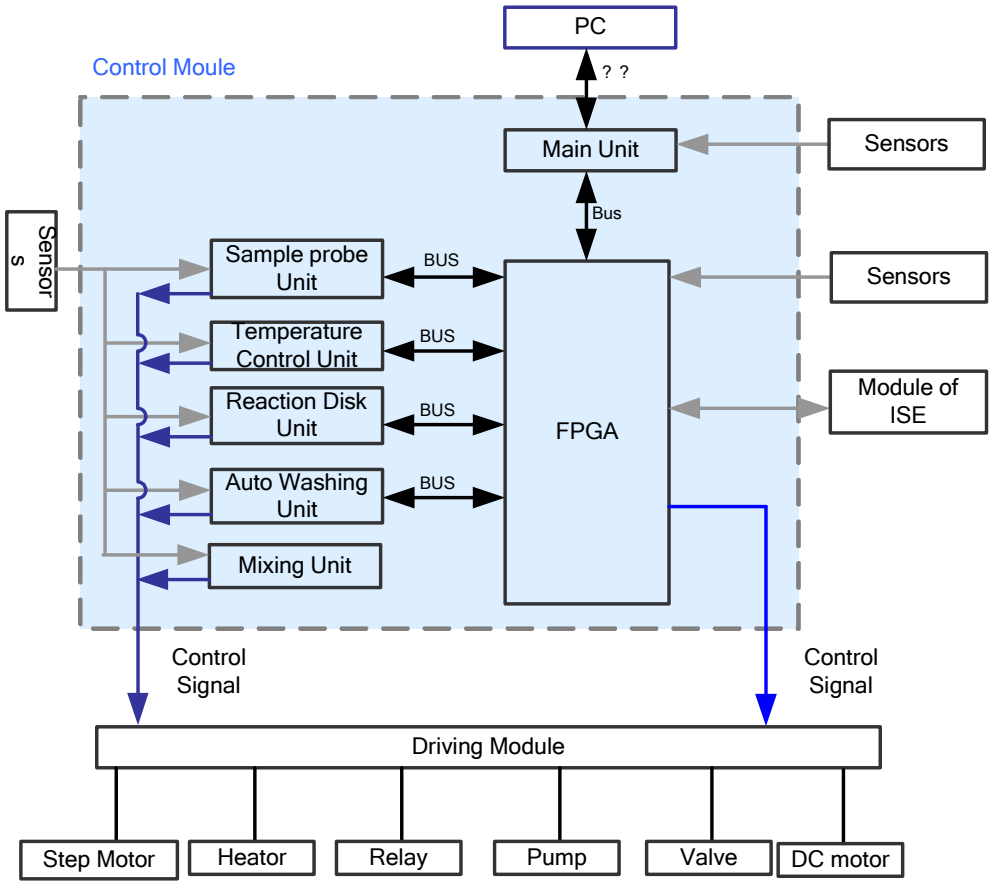
The function of the main board:

- Transmitting the data and commands with PC through RS232.
- Communicating with the sub-units(including ISE), transmitting the data and commands through the extended RS232.
- Adjusting the numeric adjustable resistor on the AD conversion board and collecting the photoelectric data.
- Controlling the rotation of step motors and driving moving units to accurate position.

- Switching pumps and valves to control the flow of liquid.
- Detecting the level of liquid and obstruction signal.
- Detecting the signal of position sensors.
- Controlling the heater for heating.
- Detecting the signal of the water surface.
- Controlling the ISE module.

Figure 6-3 shows the function framework of the main board.

Figure 6-3 Function of the Main Board



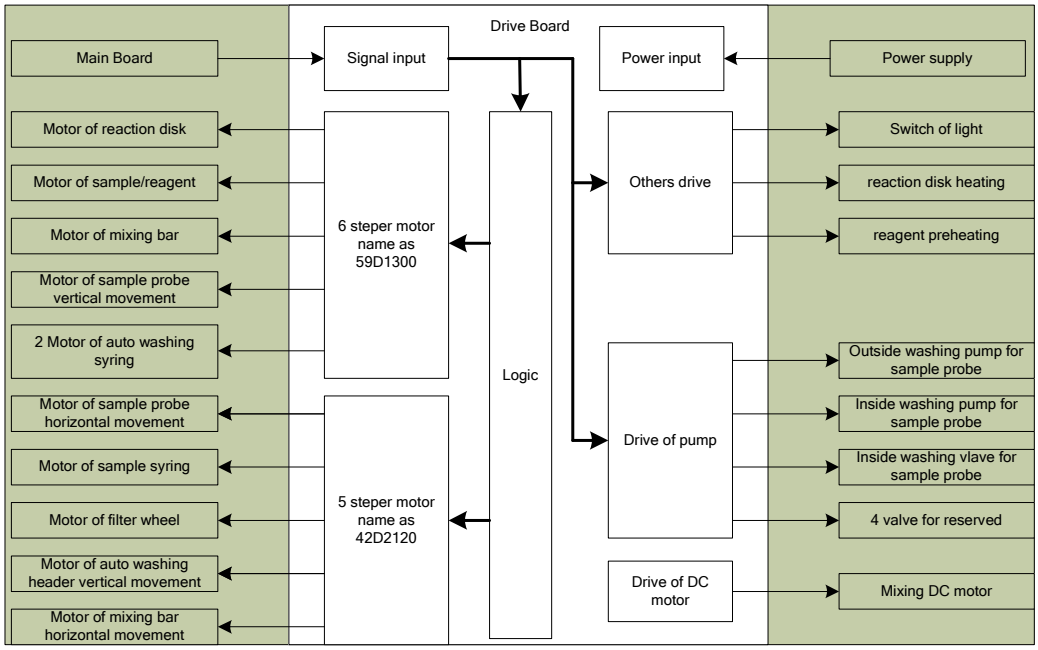
6.6.3 Drive Board

The drive board is to receive the control signals from the main control board and control the drive components, such as the reaction disk, the reagent\sample disk, the sampling probe, the mixer and the filter wheel. It also controls the switches of two pumps, the valves, the lamp and the temperature controlling system. The detaied functions are:

- Controlling the movement components
- Controlling the pumps and the valves
- Controlling lamp
- Controlling heater

Figure 6-4 shows the function framework of the drive board.

Figure 6-4 Function of the Drive Board



6.6.4 Pre-amp Board

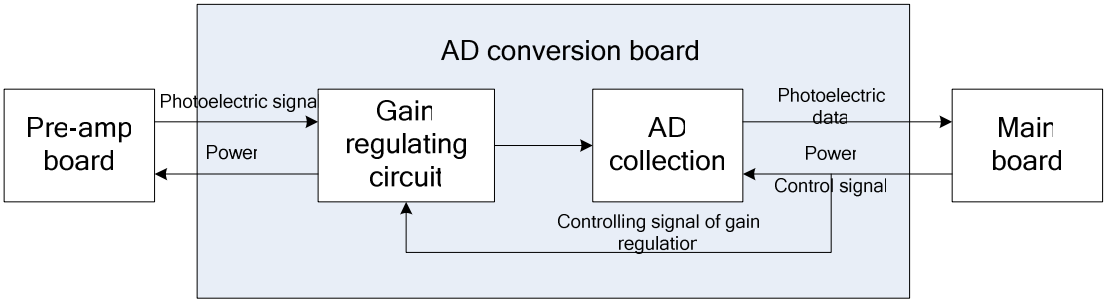
The Pre-amp circuit board can converse the light signals into electrical analog signals by the photoelectric diode. The photoelectric diode converses the light signal into the current signal in different wavelengths and the Pre-amplifier turns the current signal to the voltage signal and transmit this signal to the AD conversion board.

6.6.5 AD Conversion Board

This unit can process the analog signals from the pre-amp board and convert the analog signals into the digital signals. The photoelectric diode converts the monochromatic light signal into the voltage signal and the signal arrives the AD input. The AD conversion board filters and amplifies it; at the same time, the AD collects the signals indicated by the signal from the main board and then sends the AD value to the main board for further process. The AD conversion board also provides power to the Pre-amp board.

Figure 6-5 shows the function framework of the AD conversion board.

Figure 6-5 AD Conversion Board



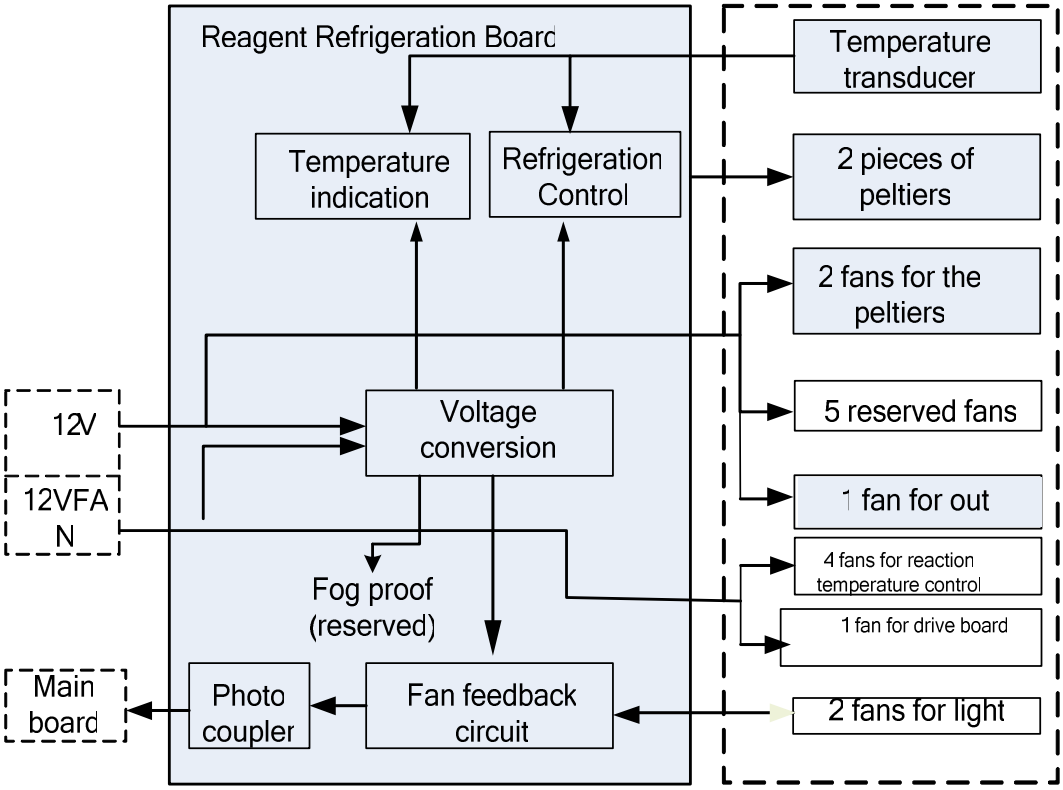
6.6.6 Reagent Refrigeration Board

Compared with other circuit boards, the reagent refrigeration board is an independent unit; it can control the cooler chip on or off and then make the reagents cool; it can adjust the temperature in the reagent carousel; also, it can drive the fans of the whole system and feedback the signal of the working status of the funs to the main board; the detailed functions are:

- Controlling the refrigeration
- Controlling the indicating LED of the refrigeration
- Controlling the fans and defogging the code scan's windows (reversed)
- Feedbacking the sigual of the working status of the fans for lamp

Figure 6-6 shows the function framework of the reagent refrigeration board.

Figure 6-6 Reagent Refrigeration Board



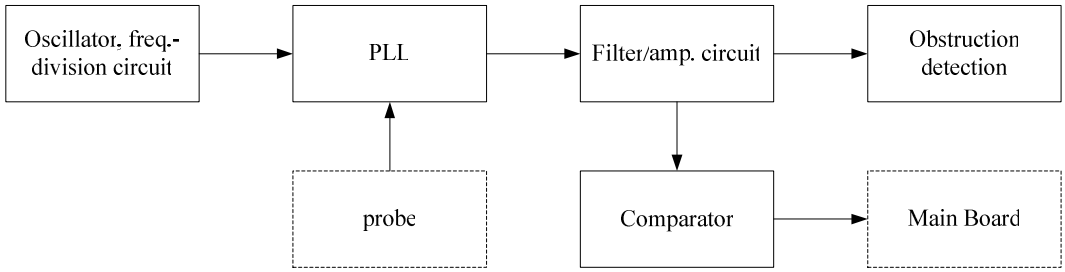
6.6.7 Level Detection Board

The board detects the liquid level, the detailed functions are:

- Detecting the reagent level and sample level with high reliability
- Transferring the level detection signal to the main board when the probe touches the liquid level
- Protecting the probe from collision vertically and generating the detection signal which is sent to the main board.

Figure 6-7 shows the function framework of the level detection board.

Figure 6-7 Level Detection Board Function



6.6.8 Reaction Disk Temperature Sampling Board

This board collects signals from the reaction disk temperature sensors and then converts them into digital signals. This board provides an SPI interface, and is connected to the main board.

6.6.9 Three Probes Connection Board

This board transfers the control signal of the reagent preheating, mixer motor pulse and level detection board.

6.6.10 ISE Power Board

The board supplies the transformation of the voltage from 12V to 24V which provides power to ISE module.

ISE module should be on power all the time, and the input 12V is provided by 5V/12V Board.

6.6.11 Heater Voltage Selecting Board

The board supplies two connection type for the 220V AC power and the 110V AC power separately. If the AC power is 220V, please use the socket for 220V; if the power is 110V AC power, please use the socket for 110V. The heater will provide the same power consumption so as to ensure the effect of the heating in the different AC power environment.

6.7 On Board LED Indication

Table 6-2 On-board LED Indication List

LED Mark	LED On	LED Off	Remark
Main board（BA10-30-77755）			
REAG	The pre-heater is heating	The pre-heater is not heating	
TRAY	The heater of reaction disk is heating	The heater of reaction disk is not heating	
ACID			reserved
ALK			reserved
TEMP	/	/	For debug use only, can be ignored
WATER			reserved

LED Mark	LED On	LED Off	Remark
5V	Indication of 5V power	Exception of 5V power	
12V	Indication of 12V power	Exception of 12V power	
3.3V	Indication of 3.3V power	Exception of 3.3V power	
MAIN	/	/	For debug use only, can be ignored
REAC	/	/	For debug use only, can be ignored
CFG	FPGA is being configured	Configuration has been finished	Off after power is on
FILL	/	/	For debug use only, can be ignored
FPGA			Flickering indicates FPGA is running
WASH	/	/	For debug use only, can be ignored
STIR	/	/	For debug use only, can be ignored
Drive board（BA10-30-77757）			
D1-24V	24V works normally	24V off or erroneously	
D2-5V	5V works normally	5V off or erroneously	
D3-12V	12V works normally	12V off or erroneously	
D16	Inside pump on	Inside pump off	
D17	outside valve on	outside valve off	
D18	outside pump on	outside pump off	
AD conversion board（BA10-30-77759）			
+15V	+15V works normally	+15V off or erroneously	
-15V	-15V works normally	-15V off or erroneously	
+5V	+5V works normally	+5V off or erroneously	
Level detection board（BA20-30-75263）			
LED1	Detecting the liquid surface	No liquid surface signal	The liquid surface signal also occurs when the electric things, such as hands or metal, contact the probe,
Reagent refrigeration board（BA20-30-75227）			
D3-12VLED	12V works normally	12V off or erroneously	
D4-RED_LED	Reagent refrigeration temperature T>10 ℃	Reagent refrigeration temperature T in other status	
D5-YELLOW_LED	Reagent refrigeration temperature T<0 ℃	Reagent refrigeration temperature T in other status	

LED Mark	LED On	LED Off	Remark
D6-GREEN_LED	Reagent refrigeration temperature 0℃ ＜T＜10℃	Reagent refrigeration temperature T in other status	
D7-PELTIER_LED	Reagent refrigeration power is on.	Reagent refrigeration power is off or erroneously.	
D8-FAN3_LED	The J73 fan block up, please check the fan.	The J73 fan works normally.	
D9-FAN1_LED	The J71 plug doesn't connect or is broken.	normal	
D14-FAN4_LED	The J74 fan block up, please check the fan.	The J74 fan works normally.	
D15-12VFAN_LED	12VFAN works normally	12VFAN off or erroneously	
D16-FAN2_LED	The J72 plug doesn't connect or is broken.	normal	
Reaction disk temperature sampling board（BA10-30-78268）			
+12V	12V works normally	12V off or erroneously	
PFC board（BA10-30-77764）			
LED1	A12V on	A12V off or erroneously	Controlled by software
24V board（BA10-30-77766）			
LED350	24V on	24V off or erroneously	
12V&5V board（BA10-30-77768）			
LED350	B12V on	B12V off or erroneously	
LED351	C12V on	C12V off or erroneously	
LED352	5V on	5V off or erroneously	

6.8 Power Supply Unit

- The power supply unit consists of three circuit boards: PFC board, 24V board and 12V&5V board.
- PFC Board:

①. EMI filter network;

②. Supplying the PFC circuit which conforms to the IEC61000-3-2 standard. Supplying the +390V to drive the 24V board and 12V&5V Board;

③. Controlling the 24V, 12V (4.7A) and 5V outputs through the switch of the analyzing unit;

④. Supplying stable 12V (4.5A) for the lamp, controlled by the system signal;

⑤. Supplying 14 V VDD voltage to drive the 24V board and 12V&5V board;

- 24V Board:

①. Converting the 390V into 24V.The 24V of this board is output under the control of the Power of the analyzing unit;

②. Transferring AC to the heater and controlling the heater;

- 12V Board:

①. B12V/10A out;

②. C12V/4.7A out;

③. The 5V/12V board converts the 390VDC from the PFC board to 12V (10A), 12V (4.7A) and 5V. The 12V (4.7A) and 5V are controlled by the switch of the analyzing unit;

- The structure of the power supply unit make it manufactured and maintained easily;
- The power supply unit is cooled by fans;

6.8.1 Features of Power Supply Unit

6.8.1.1 Input

- Input AC voltage : 100～240V（±10%）
- Frequency: 50/60±3HZ
- Input Power: 800VA

6.8.1.2 AC Output

- AC output: 90～264V
- Frequency: 50/60±3HZ
- Output power:470VA

6.8.1.3 DC Output: 5V-for Circuit Boards

- Output current:: 4.5A
- Output voltage: 4.85～5.25V
- Output ripple noise: 100mVp-p

6.8.1.4 DC Output: A12V-for Lamp

- Output voltage: 11.75～12.25V
- Output ripple noise: 100mVp-p
- Control request: A12V is controlled by an analog signal from the system
- Output current: 2A
- Insulation: A12V have not electrical connection with other power

6.8.1.5 DC Output: B12V-for Refrigeration and Fans

- Output current:: 10A, Inrush current 14A, continuing 300ms
- Output voltage : 11.8～12.8V
- Output ripple noise: 140mVp-p

6.8.1.6 DC Output: C12V-for Pumps, Valves and Boards

- Output current:: 4.7A
- Output voltage: 11.8～12.8V
- Output ripple noise: 140mVp-p

6.8.1.7 DC Output: 24V-for Motors and Boards

- Output current:: 5 A
- Output voltage: 23.5～25V
- Output ripple noise: 140mVp-p

6.8.2 Protective Function of Power Supply Unit

6.8.2.1 Over-current Protection

- All the output current have over-current protection
- The over-current protection point is in the range of 105～140% of the normal output current except the A12V&B12V. Make sure the A12V&B12V are safe and reliable before the current is over the the over-current protection point
- The status after protection: The statuses after protection are board-locked except A12V which is the system-locked protection.

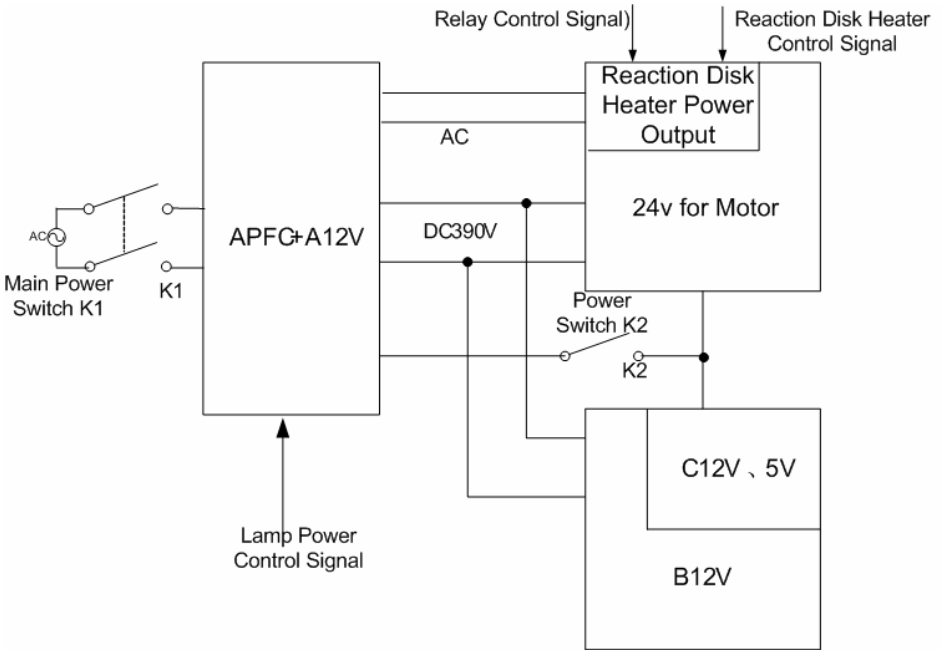
6.8.2.2 Over-volt Protection

- All the output volts have the locked over-volt protection.
- The protection point of the over-volt is 115-140% of normal volt.
- The status after over-volt protection is just the same as the status after over-current protection.

6.8.3 Block Diagram

Figure 6-8 shows the framework of the power unit.

Figure 6-8 Framework of Power Supply Unit



6.9 Connection Diagram

Appendix A shows the system connection diagram.

7 Service and Maintenance

To ensure the reliability, the good performance and the service life of the system, regular maintenance is required. Follow the instructions given below to maintain the system. Even you're only an operator, it's very important for you to learn this chapter. Your thorough understanding will help you obtain the best performance of the system.

WARNING

Do not perform any maintenance procedures that are not described in this chapter.Otherwise, system damage and personal injury may be caused.

Do not touch the parts other than specified.

Performing unauthorized maintenance procedures may damage your system, void any applicable warranty or service contract and even cause personal injury.

After performing any maintenance actions or procedures, ensure that the system runs normally.

Do not spill water or reagent on mechanical or electrical components of the system.

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles during maintaining process.

7.1 Preparation

The following tools, wash solution and ethanol may facilitate your maintenance.

7.1.1 Tools

1. Hex wrenches (M1.5, M3 and M4)
2. Cross-headed screwdrivers (large, medium and small)
3. Tweezers
4. Clean cup
5. Clean gauze
6. Clean cotton swabs
7. Clean brush
8. Syringe needle tube

7.1.2 Wash Solution

1. Acid: 0.1mol/l hydrochloric acid
2. Alkaline: CD80 wash solution

WARNING

Poisonous gas will be produced if acid wash solution is mixed with alkaline wash solution. Do not mix the acid wash solution with the alkaline one.

CAUTION

Mindray has specified the following enhanced wash solutions:

Acid: 0.1mol/l hydrochloric acid; Alkaline: CD80 wash solution.

Use the enhanced wash solution specified by Mindray. Otherwise, proper result may not be obtained.If wash solution other than the specified are used, you may not obtain reliable results.

Mindray recommends the acid and alkaline wash solutions be used alternately. For instance, if the acid wash solution is used at current startup, the alkaline one should be used at next startup.

7.1.3 Others

1. Water-free ethanol
2. Disinfectant

7.2 Daily Maintenance

7.2.1 Checking Remaining Deionized Water

CAUTION

The water must meet requirements of the CAP Type II water.

When placing the deionized water tank, ensure the height difference between the top of the tank and the bottom of the upper cabinet is within 500-800mm.

Ensure the deionized water pickup tube is not blocked, bent, or twisted.

1. Check how much deionized water is left in the tank before test.If enough, proceed to the 5th step. If not much, proceed to the next step.
2. Unscrew (counter-clockwise) the tank cap and remove the cap together with the pickup tube and the sensor.

CAUTION

After removing the cap of the deionized water (together with the pickup tube and sensor), place it on a clean table.

3. Add deionized water to the tank.
4. Screw (clockwise) the cap together with the pickup tube and the sensor back onto the tank until secure.
5. Ensure the deionized water pickup tube is not blocked, bent, or twisted.

7.2.2 Emptying Waste Tank

BIOHAZARD

In case your skin contacts the sample, control or calibrator, follow laboratory safety procedure and consult a doctor.

Dispose of the wastewater in accordance with your local or national guidelines for biohazard waste disposal, and consult the manufacturer or distributor of the reagents for details.

CAUTION

When placing the waste tank, ensure the height difference between the top of the tank and the bottom of the upper cabinet is within 500-800mm.Ensure the deionized water pickup tube is not blocked, bent, or twisted.

A blocked, bent or twisted waste tube may lead to wastewater overflow, which may damage the analyzer.

1. Check how much space left in the waster tank before the test. If enough, proceed to the 5th step. If not enough, proceed to the next step.
2. Unscrew (counter-clockwise) the tank cap and remove the cap together with the pickup tube and the sensor.

BIOHAZARD

After removing the cap of the waste tank (together with the tube and sensor), place it on an appropriate place to avoid biohazard contamination.

3. Empty the waste tank.
4. Screw (clockwise) the cap (together with the waste tube and the sensor) back onto the tank until secure.
5. Ensure the deionized water pickup tube is not blocked, bent, or twisted.

7.2.3 Checking Connection of Deionized Water

1. Check the connections between the two connectors marked DEIONIZED WATER on the analyzing unit and their counterparts. If you see leaks, wipe off the water with clean gauze and tighten the connections and proceed to the next step.
2. Check whether the cap of the deionized water tank is loose.
3. Ensure the waster pickup tube is not blocked, bent, or twisted.
4. Check whether the sensor of the deionzed water is well connected.

7.2.4 Checking Connection of Waste Water

BIOHAZARD

In case your skin contacts the sample, control or calibrator, follow laboratory safety procedure and consult a doctor.

Dispose of the used gauze in accordance with your local or national guidelines for biohazard waste disposal.

1. Check the connections between the connector marked WASTE on the analyzing unit and its counterpart. If you see leaks, wipe off the waste with clean gauze and tighten the connections and proceed to the next step.
2. Check whether the cap of the waste tank is loose.
3. Ensure the waste pickup tube is not blocked, bent, or twisted.
4. Check whether the sensor of the waste is well connected.

7.2.5 Checking Syringe

1. Place the Power to OFF.

2. Unscrew the screws on the syringe cover and remove the cover.
3. Check whether the syringe T-piece leaks. If yes, find the reason and replace the tube, T-piece and connector in time.
4. Check whether the plunger guide cap leaks. If yes, replace the syringe plunger. Refer to 7.6.7 *Replacing Plunger Assembly of Syringe* for details.
5. Check whether there is bubble in the syringe.If yes, remove the bubble. Please refer to 7.6.8 *Removing Air Bubbles* for details to remove air bubbles.
6. Place the cover of the syringe back and tighten the screws.

7.2.6 Checking/Cleaning Sample Probe

WARNING

Be careful to avoid injury by the probe tip.

BIOHAZARD

In case your skin contacts the sample, control or calibrator, follow laboratory safety procedure and consult a doctor.

1 On the ***Daily Maint.*** page, select ***System Reset*** and then click ***Execute*** to clean the sample/reagent probe.

2 Check if the flow from the inside of the sample/reagent probe is continuous and in the direction of the probe. Check the exterior of the sample/reagent probe to see whether the flow is continuous and normal.

If not, clean the sample/reagent probe. Please refer to*7.6.4 Unclogging sample Probe* for details.

If the flow remains abnormal, check the corresponding tubing and ensure the water tank supplies water correctly with normal pressure.

3 Check whether the probe tip has remaining liquid on it. If yes, the sealing of the fluid path might not be in good condition. Check the connection of the fluid path.

7.2.7 Checking/Cleaning Mixing Bar

BIOHAZARD

In case your skin contacts the sample, control or calibrator, follow laboratory safety procedure and consult a doctor.

1 On the ***Daily Maint.*** page, select ***System Reset*** and then click ***Execute*** to clean the mixer.

2 During the cleaning process, check whether the mixer rotates correctly and water surge in the wash pool of mixer works normally.

If not, check corresponding tubing and ensure the water tank supplies water correctly with normal pressure.

7.2.8 Checking Printer/Printing Paper

Check if the power and status indicators on the printer are illuminated correctly, and if sufficient paper is prepared.

7.2.9 Checking ISE Unit (Optional)

7.2.9.1 Daily Cleaning

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles.

Wash In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

CAUTION

Please use Mindray-recommended consumables.Other consumables may decrease the system performance.

For more information about the wash solution, please refer to its instruction manual.

NOTE

The maintenance is necessary to be performed when the ISE unit (optional) is connected.

You should perform the maintenance once a day after all the samples are analyzed. Besides, if the samples of a day requested for the ISE tests are 50 or more, you should perform the maintenance after 50 samples are analyzed.

If you give the electrodes some time to stabilize after cleaning, you will experience slightly better performance.

1 Enter the ***ISE*** screen of the ***Maintenance*** of the system software.

2 Select ***Clean Cycle*** from the Instructions list.

3 Select ***Execute***. The ***Confirm*** dialog box pops up. Select ***OK*** to start the clean cycle.

4 After cleaning, if there are samples requested for the ISE tests to be run, calibration should be run first. But Mindray recommends running an ISE calibration after cleaning.

ISE unit daily cleaning can be configured to operate automatically.

7.2.9.2 Pump Calibration

1 Enter the ***ISE*** screen of the ***Maintenance*** of the system software.

2 Select ***Pump Calibration Cycle*** from the Instructions list.

3 Select ***Execute***. The ***Confirm*** dialog box pops up. Select ***OK*** to start calibrating the peristaltic pumps.

Pump calibration can be configurated to operate automatically.

7.3Weekly Maintenance

7.3.1 Cleaning Sample Probe

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

In case your skin contacts the sample, control or calibrator, follow laboratory safety procedure and consult a doctor.

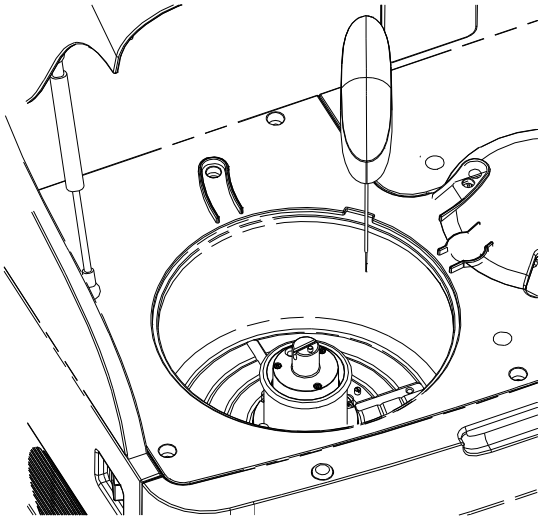
Dispose of the used gauze in accordance with your local or national guidelines for biohazard waste disposal.

1 Place the Power to OFF.

2 Remove the cover from the sample/reagent disk.

3 Remove the sample/reagent disk.

4 Pull the probe arm to the highest point by hand. Rotate the probe arm to move the probe to a position above the sample/reagent compartment and convenient to operate.



5

CAUTION

The tweezers may scratch the probe. Exercise caution when using it to clean the probe. Avoid direct contact between the tweezers and the probe. Do not use excessive force when cleaning the probe. Otherwise it may bend.

NOTE

Mindray recommends the acid and alkaline detergents be used alternately for this purpose. For instance, if the acid detergent has been used for last maintenance, the alkaline detergent had better be used for this time.

Use tweezers to pinch acid or alkaline detergent-soaked gauze, and then gently clean the exterior of the probe until it is clean and smooth.

6 Use tweezers to pinch deionized water-soaked gauze to clean the probe.

7 After cleaning, gently pull the probe arm to its highest point and rotate the probe arm to move the probe to a position above the wash pool.

8 Load the sample/reagent disk.

9 Install the sample/reagent disk cover.

7.3.2 Cleaning Mixing Bar

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

In case your skin contacts the sample, control or calibrator, follow laboratory safety procedure and consult a doctor.

Dispose of the used gauze in accordance with your local or national guidelines for biohazard waste disposal.

1 Place the Power to OFF.

2 Gently pull the bar arm to its highest point and rotate it to move the bar to a position convenient to operate.

3

CAUTION

The tweezers can scratch the bar. Exercise caution when using the tweezers to clean the bar. Avoid direct contact between the tweezers and the bar. Do not use excessive force when cleaning the bar. Otherwise it may bend.

NOTE

Mindray recommends the acid and alkaline detergents be used alternately for this purpose. For instance, if the acid detergent has been used for last maintenance, the alkaline detergent had better be used for this time.

Use tweezers to pinch acid or alkaline detergent-soaked gauze, and then gently clean the exterior of the mixing bar until it is clean and smooth.

4 Use tweezers to pinch deionized water-soaked gauze to clean the mixing bar.

5 After cleaning, gently pull the bar arm up and rotate the bar arm to move the bar to a position above the wash pool.

7.3.3 Cleaning Sample/Reagent Compartment

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

In case your skin contacts the sample, control or calibrator, follow laboratory safety procedure and consult a doctor.

Dispose of the used gauze in accordance with your local or national guidelines for biohazard waste disposal.

1 Place the Power to OFF.

2 Remove the cover from the sample/reagent disk.

3 Take out all calibrators, controls, samples, reagents, distilled water and detergent from the sample/reagent disk.

4 Remove the sample/reagent disk.

5 Wash the disk with clean water and wipe it dry with clean gauze.

6 Use clean gauze (water or disinfector-dipped gauze if necessary) to clean the inside of the compartment.

7 Load the sample/reagent disk.

8 Install the sample/reagent disk cover.

7.3.4 Cleaning Panel of Analyzing Unit

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

In case your skin contacts the sample, control or calibrator, follow laboratory safety procedure and consult a doctor.

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

1 Place the Power to OFF.

2 Wipe the panel of the analyzing unit with clean gauze (water or disinfector-dipped gauze if necessary).

7.3.5 Washing Deionized Water Tank

CAUTION

The water must meet requirements of the CAP Type II water.

When placing the deionized water tank, ensure the height difference between the top of the tank and the bottom of the upper cabinet is within 500-800mm.

Ensure the deionized water pickup tube is not blocked, bent, or twisted.

1 Place the Power to OFF.

2

CAUTION

After removing the cap of the deionized water (together with the pickup tube and sensor), place it on a clean table.

Unscrew (counter-clockwise) the tank cap and remove the cap together with the pickup tube and the sensor.

3 Wash the tank interior with deionized water. Use a clean brush to clean the interior if necessary.

4 Wash the pickup tube and the sensor with deionized water. Use clean gauze to wash them if necessary.

5 Wipe water off the tank exterior, pickup tube and sensor cable with clean gauze.

6 Add deionized water into the tank.

7 Screw (clockwise) the cap together with the pickup tube and the sensor back onto the tank until secure.

NOTE

The tank should be cleaned every week. Use brush to clean the tank walls if necessary. Check for contamination and impurity on the tank walls and bottom, after cleaning.

If the tank will not be used for a long time, put it upside down to drain the water and then store it in dry and clean environment. Clean it with water before reusing.

7.3.6 Washing Waste Tank

BIOHAZARD

In case your skin contacts the sample, control or calibrator, follow laboratory safety procedure and consult a doctor.

Exercise caution and do not spill the waste onto other people or things.

Dispose of the wastewater in accordance with your local or national guidelines for biohazard waste disposal, and consult the manufacturer or distributor of the reagents for details.

Dispose of the used gauze in accordance with your local or national guidelines for biohazard waste disposal.

CAUTION

When placing the waste tank, ensure the height difference between the top of the tank and the bottom of the upper cabinet is within 500-800mm.Ensure the deionized water pickup tube is not blocked, bent, or twisted.

A blocked, bent or twisted waste tube may lead to wastewater overflow that may damage the analyzer.

1 Place the Power to OFF.

2 **BIOHAZARD**

After removing the cap of the waste tank (together with the tube and sensor), place it on an appropriate place to avoid biohazard contamination.

Unscrew (counter-clockwise) the tank cap and remove it together with the waste tube and the sensor from the tank.

3 Empty the waste tank.

4 Wash the tank interior with clean water. Soak the tank with disinfector if necessary.

5 Wash the waste tube and the sensor with clean water.

6 Wipe water off the tank exterior, waste tube and sensor cable with clean gauze.

7 Screw (clockwise) the cap (together with the waste tube and the sensor) back onto the tank until secure.

7.4Monthly Maintenance

7.4.1 Cleaning Wash pool of Probe

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles.

Dispose of used cotton swabs in accordance with your local or national guidelines for biohazard waste disposal.

1 Place the Power to OFF.

2 Pull the sample probe arm to the highest point by hand. Rotate the bar arm to move the probe to a position convenient to operate.

3 Clean the inside of and the place around the wash pool with cotton swabs.

4 Rotate the sample probe back to a position above the wash pool.

7.4.2 Cleaning Wash pool of Mixing Bar

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles.

Dispose of the used cotton swabs in accordance with your local or national guidelines for biohazard waste disposal.

1 Place the Power to OFF.

2 Gently pull the bar arm to its highest point and rotate it to move the bar to a position convenient to operate.

3 Clean the inside of and the place around the wash pool with cotton swabs.

4 Pull the mixing bar arm to its highest point and rotate it to move the bar to a position above the wash pool.

7.4.3 Cleaning Sample/Reagent Rotor

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles.

Dispose of the used gauze in accordance with your local or national guidelines for biohazard waste disposal.

1 Place the Power to OFF.

2 Pull the probe arm to its highest point.

3 Wipe the rotor with clean gauze

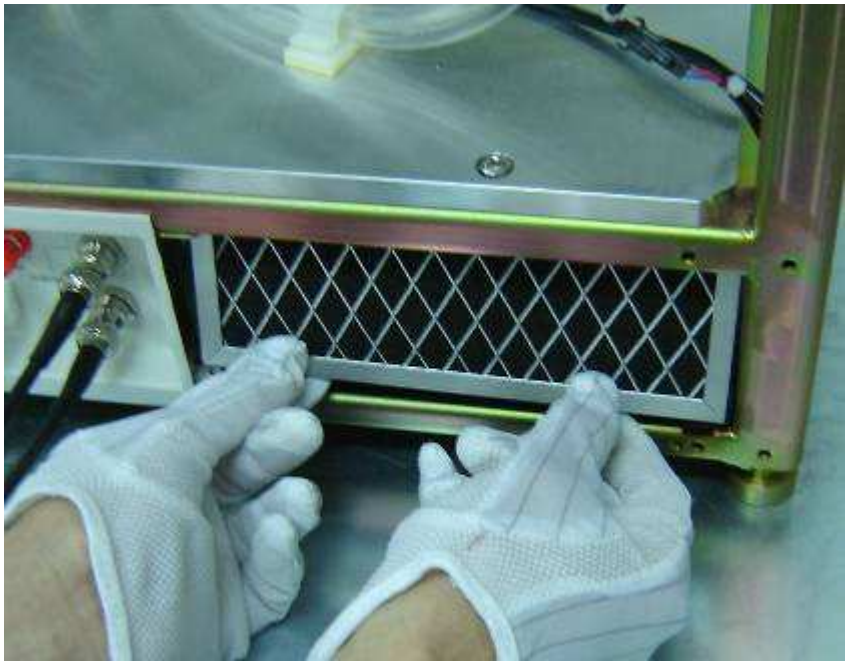
7.5 Three-month Maintenance

7.5.1 Washing Dust Screen

1 Place the Main Power to OFF.

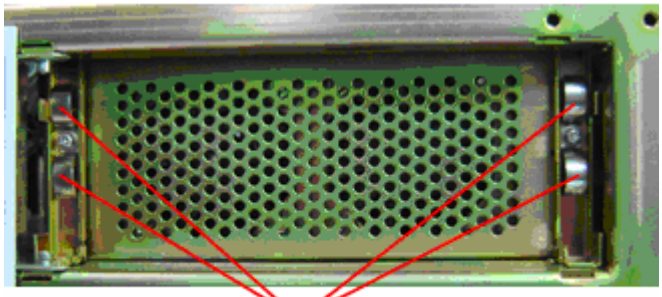
2 Use a screwdriver to unscrew the screws on the right plate and remove the right plate.You can see the front and back dust screen on the right side.The dust screen is fixiated by the bullet and stop plate.

3 Hold the screen with your hands and lift it upwards, then remove it outwards.



4 Wash the screens with clean water and dry them by airing.

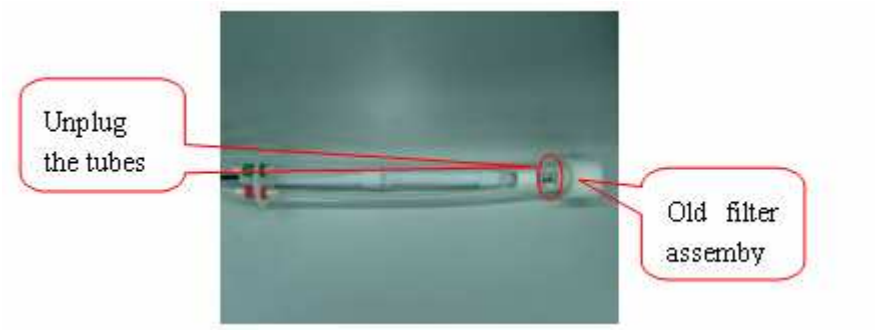
5 Make the dust screen press the bullet indicated in the figure. Press the dust screen inwards and downwards.



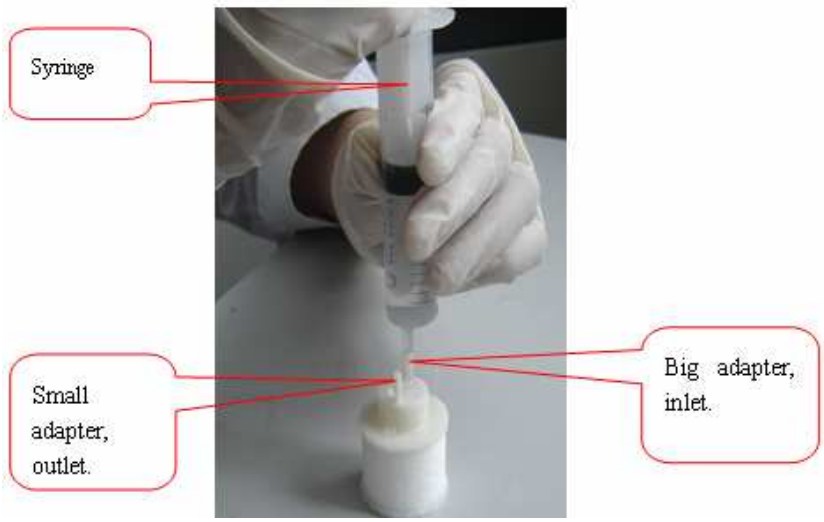
6 Install the right plate with screws.

7.5.2 Replacing Filter Assemby

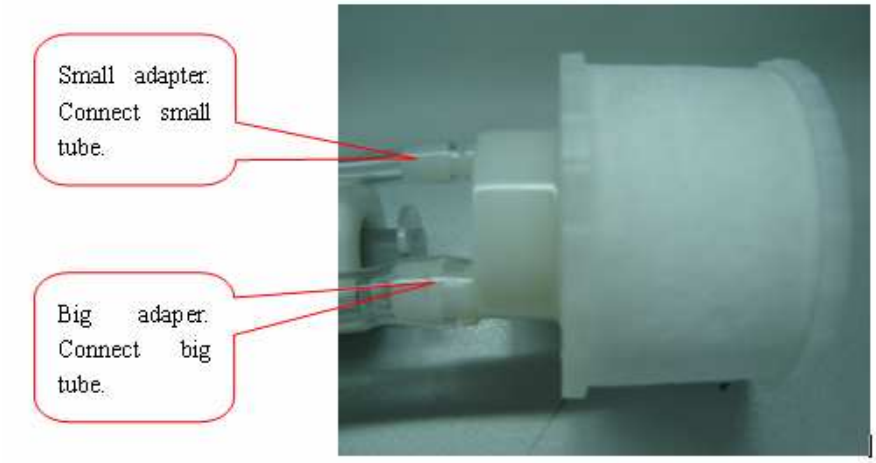
1 Remove cap assembly from the DI water tank and place it on a clean desktop. Carefully remove the filter assembly from the cap assembly.



2 Inject water into the new filter assembly through the big adapter by using the syringe. When water wells up from the small adapter, the injection is completed. Purpose: increase the weight of the filter assembly to make it sink to the bottom of the water tank.



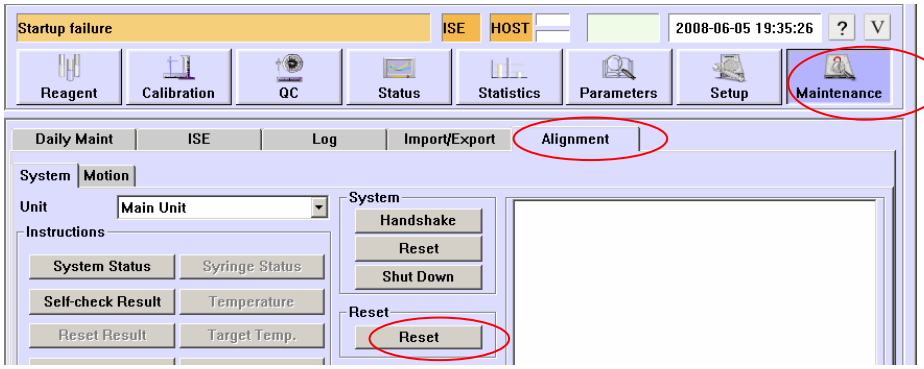
3 Connect the new filter assembly to the tubes of the cap assembly.



4 Expel air from the filter assemby

(1) Place the Main Power and Power of the analyzer to ON. Turn on the computer and start the operating software.

(2) Reset 10 times (click Maintenance and then select Alignment, click Reset) to expel the air in the filter assemby and the tubes.



(3) Check for large amount of buubles in the outlet tube. If yes, continue the resetting process; if not, the air expelling is completed.

5 The installation is completed.

7.6Irregular Maintenance

7.6.1 Checking photoelectric system performance

Check the performance of the optical system under the following conditions:

1. Lamp is replaced or reinstalled;
2. Filter is replaced or reinstalled;
3. Abnormal test data.

Please refer to *4.6.4.4 Checking Performance of Photometer* for details.

7.6.2 Replacing the lamp

The lamp is tungsten-halogen lamp. It is necessay to replace it after the instensity drops to a certain degree.

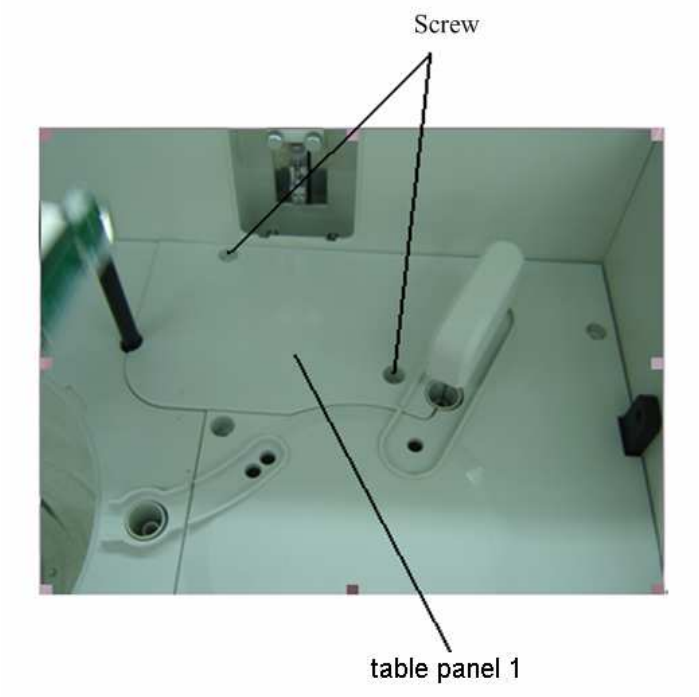
1. Place the Main Power to OFF. Wait at least 15 minutes until the lamp and its housing cools down.

WARNING

Do not touch the lamp before it cools down, or you may get burned.Do not proceed with this procedure until they have cooled down.

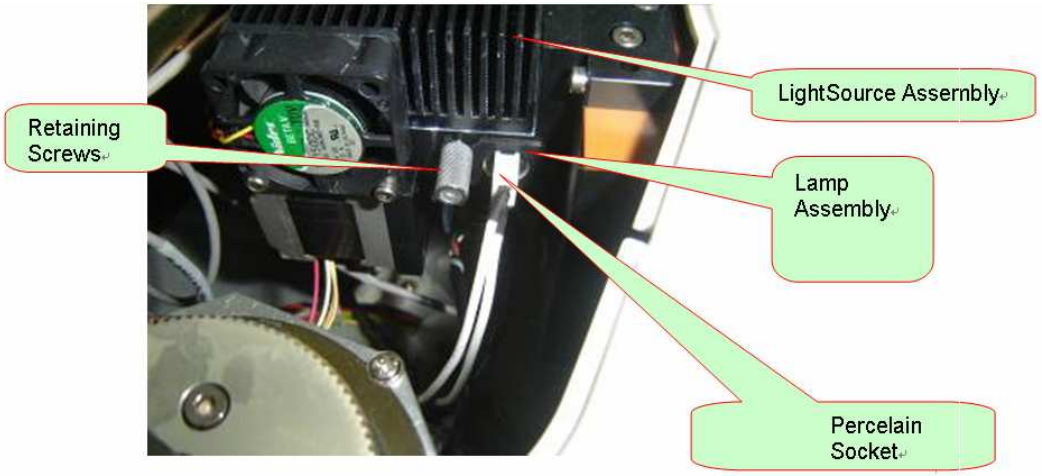
2. See Figure 7-1, Unsrew the two screws on the table panel 1 and remove it.

Figure 7-1 Remove the Table Panel



3. Loose the retaining screw manually for about 5-7 circles (do not get the screw out).

Figure 7-2 The Vew after Table Panel is Removed



4. Use your finger to pinch the porcelain socket and pull it out for 3mm, and then rotate 45 degrees counterclockwise, to pull the lamp assembly out completely.

5. Use one hand to pinch the porcelain socket and the other to pinch the lamp assembly.

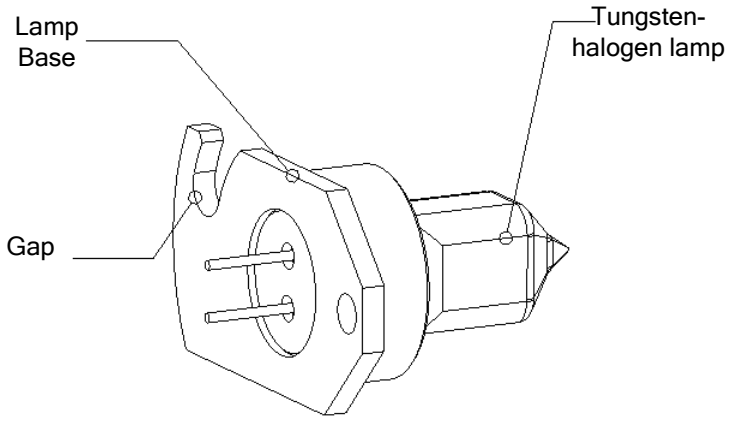
6. Place the new lamp assembly into the porcelain socket.

7. Place the lamp base part with gap to the hole of the light source. When the lamp base reaches half of the depth, rotate it clockwise until the restraining screw is fixed.

8. Screw the retaining screw on the lamp base.

9. After the lamp assembly is assembled and the socket is fixed, install the table panel.

Figure 7-3 Light Assembly Structure

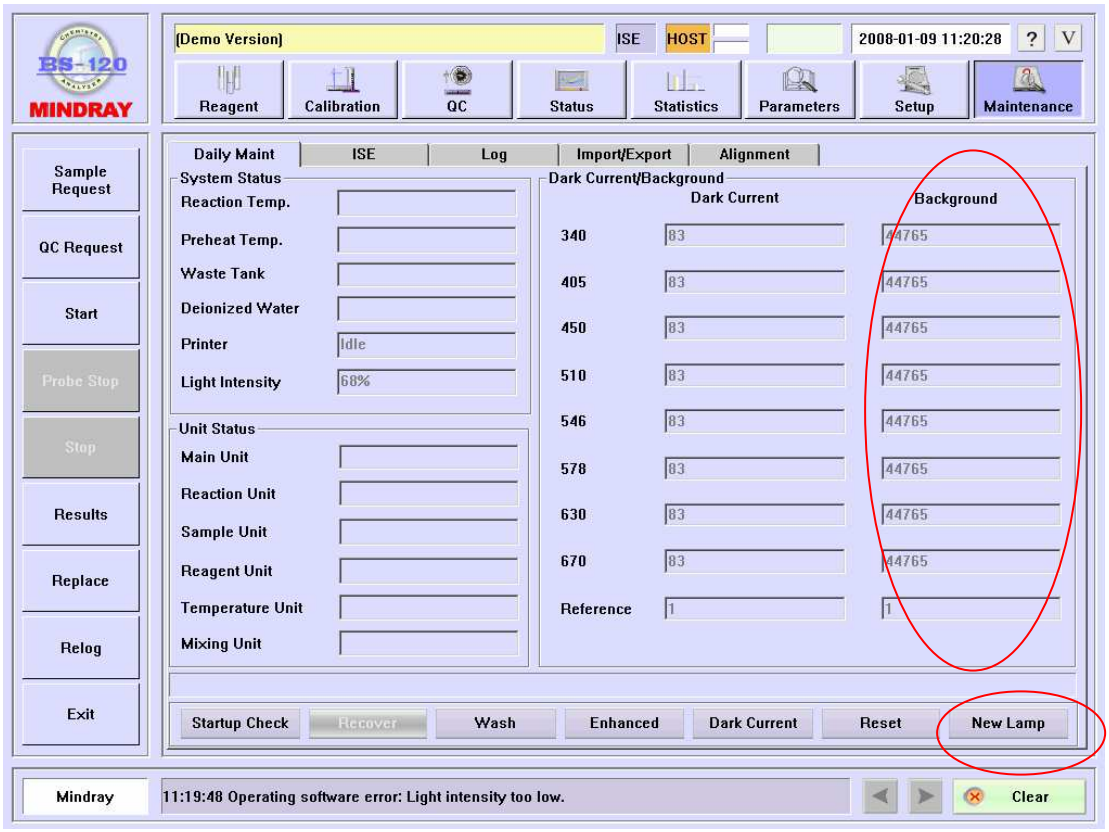


10. Place the Power back to ON.

11. Log on the test and maintenance software. Username: bs120, Password: BS20@Mindray!

12. Wait 20 minutes until the light source is stable, and then enter the Maintenance screen and click New Lamp. Follow the software instruction to refresh the air blank AD value (Background value).

Figure 7-4 Refresh the Air Blank AD after Replacing the Lamp



13. Check the air blank AD (Background value) after executing New Lamp.The replacement is successful when the value of all channels is below 65535.If the background is above 65535, the background overflows and it is necessary to adjust the gain.

14. The photometric performance after replacement should be checked. Please refer to *4.6.4.4 Checking Performance of Photometer* for details.

NOTE

The background should not be too high after replacement. It is recommended to adjust the gain when the background is above 62000.

Precautions:

1. Replace the lamp assembly as a whole.

2. Wear white clear cotton gloves while replacing the lamp. Don't pinch the bulb of the lamp so that the lamp will not be contaminated or broken.

3. Check the installation of the light base and the porcelain socket after replacement.

7.6.3 Replacing the Filter

It is necessary to replace the filter when it is damaged or aged. The steps of replacing filters are as follows.

1. Place the Power to OFF.

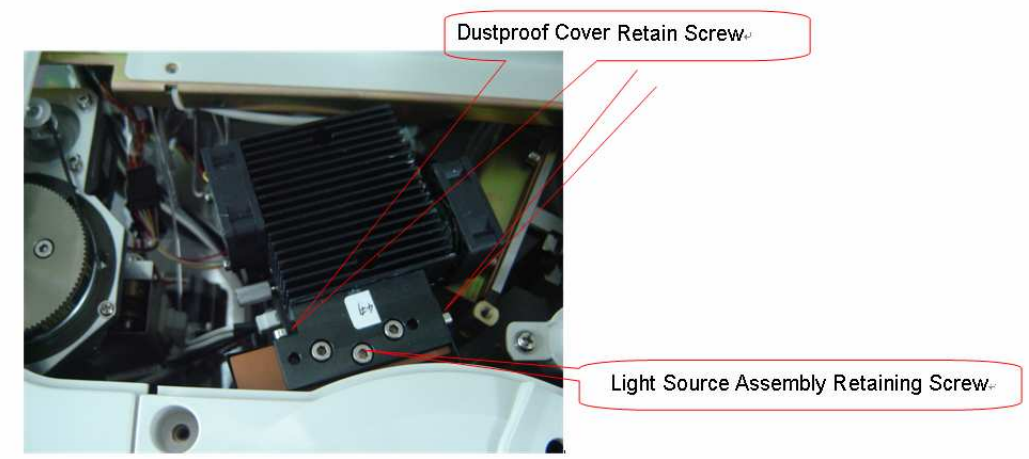
2. Remove the rear panel and the table panels 1 of the analyzing unit.

3. Pull out the porcelain socket, the cooling fan of the optical module, the sensor and the motor cable socket.

4. Unscrew the three screws fixing the light source assembly to remove it.

5. Unscrew the two screws fixing the dustproof cover and remove the plate.

Figure 7-5 Removing the Light Source Assembly



6. Use the fixture BA10-J12-01 (see Figure 7-6) to cover the filters and then unscrew the 8 screws fixing the filter by using the cross-head screwdriver. It is necessary to use the fixture to protect the filters from being scratched. If you can not find the fixture on the spot, handle carefully.

Figure 7-6 Fixure

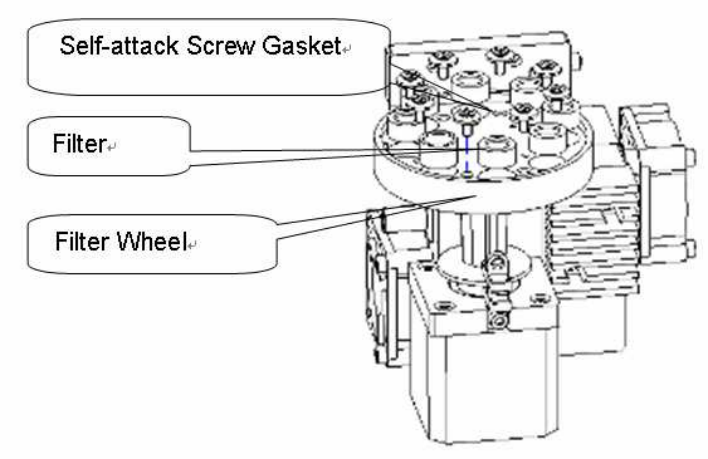
7. Push the filter out with cotton swabs.

8. The corresponding relationship between the filter and the filter wheel installation hole is :

Wavelength（nm）	340	405	546	670	450	510	578	630
Hole Position	1	2	3	4	5	6	7	8

Pay attention to the direction of the filter wheel during installation. The arrow on the filter wheel indicates the direction of the light path, or put the end surface with chamfer angle to the bottom of the installation hole.

Figure 7-7 Filter Assembling Structure



9. Install the filter to the filter wheel hole with the right order and direction. Cover the filter with fixture BA10-J12-01 and tighten the 8 screws on the filter. If you can not find the fixture on the spot, handle carefully.

10. Install dustproof cover.

11. Install the optical module back.

12. Pull out the porcelain socket, the cooling fan of the optical module, the filter wheel home position sensor cable and the motor cable socket.

13. Turn on the power, and check the movement of the filter wheel. Install the front plate and the back panel when the lamp is turned on.

14. Confirm the photoelectric performance after replacement. Please refer to *4.6.4.4 Checking Performance of Photometer* for details.

Precautions:

1. Wear white clear cotton gloves while operating.
2. Do not get the filter damaged while screwing the screws.
3. Press the filter gently into the installation hole on the filter wheel.
4. If there is dirty on the surface of the filter, clean it with ethanol-soaked defatted cotton.
5. Check the rotation of the filter wheel.

7.6.4 Unclogging Sample Probe

When the probe is clogged, the fluid flow will become abnormal.

Follow this procedure to remove, unclog and install the sample probe.

7.6.4.1 Removing Probe

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

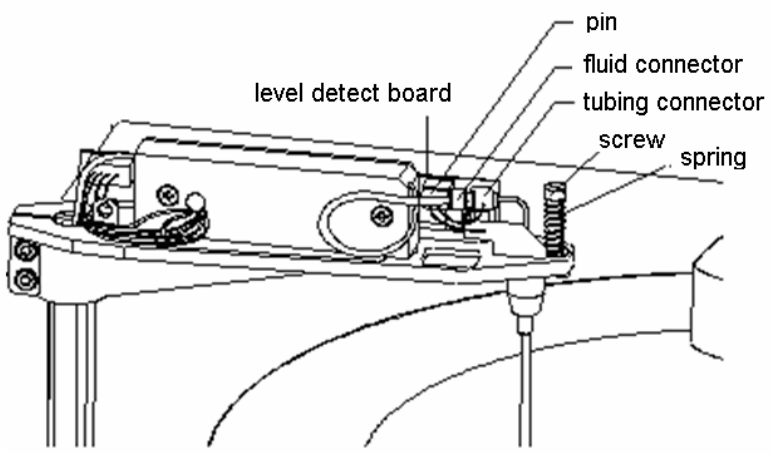
Wear gloves and lab coat and, if necessary, goggles.

1 Place the Power to OFF.

2 Remove the sample/reagent disk.

3 Pull the probe arm to the highest point by hand. Rotate the probe arm to move the probe to a position above the sample/reagent compartment and convenient to operate.

4 Grab the lower part of the arm cover with two hands and pull them slightly outwards and remove the cover upward from the arm base. After you remove the cover, the inside structure of the probe arm is as shown in the figure below.



5 Hold the probe's fluid connector with one hand and the tubing connector with the other. Rotate the tubing connector counter-clockwise until it disconnects from the probe. Remove the tubing from the probe.

If you are going to use a unclogging device to clean the probe, perform the steps in section 7.6.4.2 Unclogging Probe.

CAUTION

There is a tiny gasket inside the fluid path connector after the probe connector is removed from the fluid path tube connector. Exercise caution so that the gasket inside the probe does not drop out and if it does, store it in a clean place for later installation.

CAUTION

To be avoid of droping water from the unplugged fluid connector, please wipe off the water with clear gauze when necessary.

6 Press the circuit board with one hand and disconnect the probe's circuit connector from the board with the other hand.

CAUTION

Exercise caution when disconnecting the connector. Excessive force may damage the connector and/or the circuit board.

Please wear the glove to protect the circuit boards from ESD or release the charge first when you handle the circuit boards.

7 Use a small screwdriver to remove the retaining screw on the probe and take out the spring.

8

WARNING

Store the removed probe in a safe place where it will neither endanger people working around the area nor be damaged.

NOTE

Exercise caution when pulling the probe away from the arm.

NOTE

A bent or damaged probe will lead to unreliable test results and should be replaced immediately.

7.6.4.2 Unclogging Probe

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

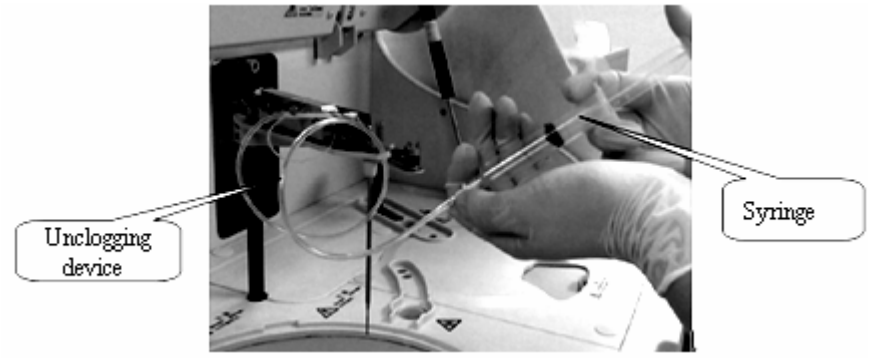
Wear gloves and lab coat and, if necessary, goggles.

Dispose of the used needle in accordance with your local or national guidelines for biohazard waste disposal.

1 Place a container like beaker below the sample probe.

2 Connect the unclogging device to the tubing connector.

3 Use a single-use syringe to aspirate 3ml CD80 wash solution, remove the needle and connect the syringe to the other end of the unclogging device. Push the syringe plunger slowly until there comes liquid out of the sample probe tip.



4 If no liquid comes out of the sample probe tip, insert a needle into the sample probe tip and push the syringe plunger.

5 Leave the sample probe soaked with wash solution for about 10 minutes. Push and pull the syringe plunger for several times until liquid comes out of the probe tip evenly.

6 Use the syringe to aspirate deionized water and rinse the sample probe for at least 3 times.

7 Remove the unclogging device and the syringe, and then connect the tubing connector.

8 Remove the container.

NOTE

A bent or damaged probe will lead to unreliable test results and should be replaced immediately.

7.6.4.3 Installing Probe

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles.

1 Place the Power to OFF.

2 Insert the probe back into the hole on probe arm, and align the hole on probe plate to the rotor inside the arm.

3 Sleeve the spring on the rotor and screw the retaining screws to secure.

4 Pinch the probe by the part near the probe arm. Gently push the probe upward and then release the probe to see if the spring can move freely.

If yes, proceed to the next step.

If not, check for errors and try again after removing the errors.

5 Connect the probe's circuit connector back to the circuit board.

6 Ensure the gasket is inside the probe.

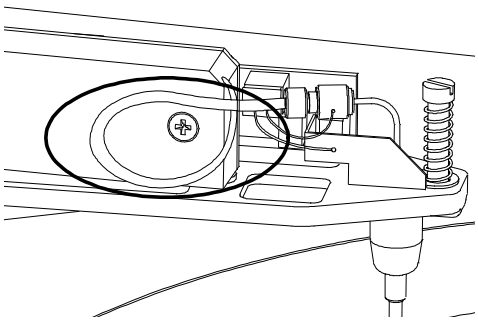
NOTE

Replace the gasket, if the probe has been removed for 2-3 times.

7

CAUTION

The fluid tube inside the probe arm should be bent into a circle when being installed.



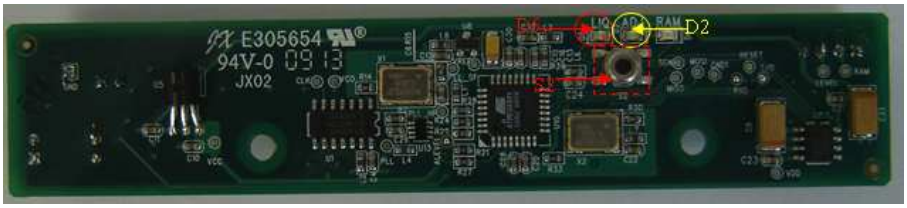
Exercise caution when connecting the probe. Excessive force may bend the probe.

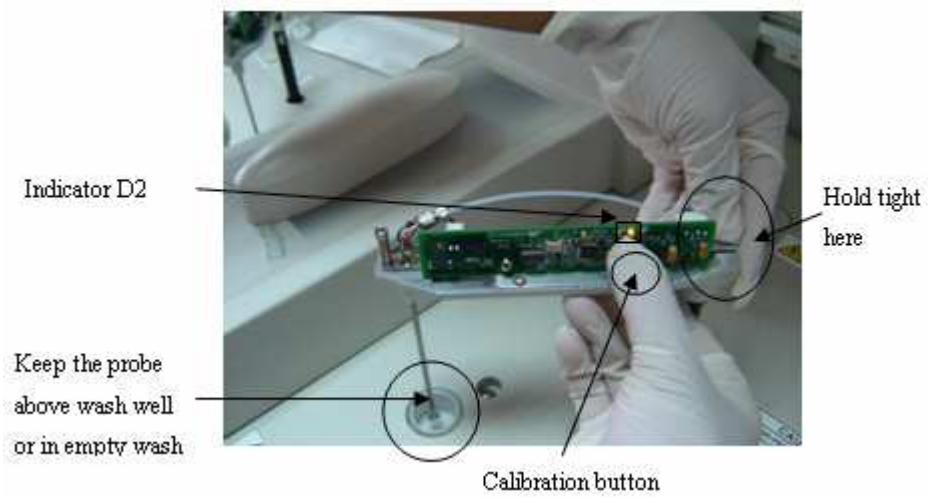
Screw (clockwise) the probe's fluid connector back to the tubing connector.

8 Place the ANALYZING UNIT POWER to ON while ensuring that the sample probe is not attaching any conducting .object, such as hands.

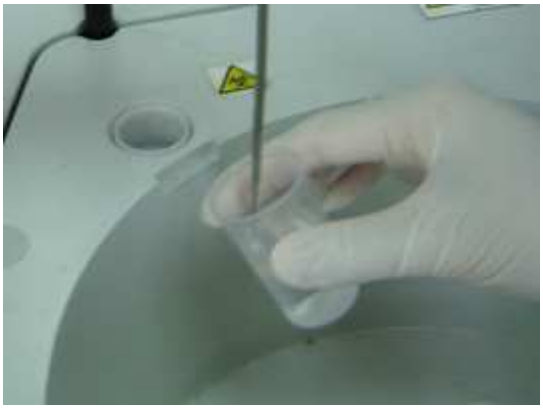
9 Calibrate the sample probe manually. Check if indicator D2 (yellow) is lightened within 2 seconds when the ANALYZING UNIT POWER to ON. Press the switch S2 on the level detection board and then release it, then check if indicator D2 is first extinguished and then lightened. If it is, that means the calibration succeeds.

Exercise caution to prevent the sample probe from attaching any conducting object during the calibration.





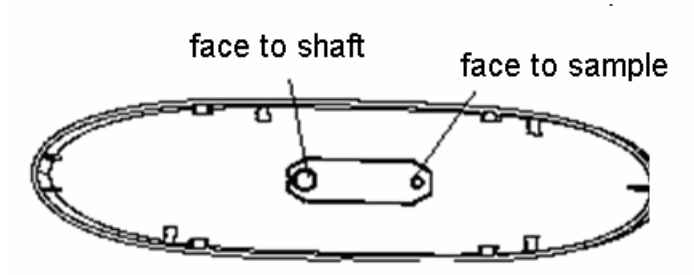
10 Add deionized water to a clean cup. Immerse the probe tip into the water by 2-3mm and indicator D5 on the circuit board should be lighted. Take the probe tip out of water, and the indicator should go out. If the test succeeds, proceed to the next step; if not, please contact our Customer Service Department or the distributor.



11 Check the marks inside the probe arm cover to see the orientation of the cover. Install the cover back to the probe arm.

CAUTION

The marks inside the probe arm cover are shown in the figure below.Do not squeeze the tube when installing the probe arm cover.



12 Pull the probe arm to its highest point and rotate it to move the probe to a position above the wash pool.

13 Load the sample/reagent disk.

NOTE

A bent or damaged probe will lead to unreliable test results and should be replaced immediately.

7.6.5 Replacing Probe

If the probe is bent or damaged, it must be replaced immediately. Follow the procedure given below to replace the damaged or bent probe.

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles.

CAUTION

Please use Mindray-recommended consumables. Other consumables may affect the system performance.

1 Remove the probe by following the procedure in *7.6.4.1 Removing Probe*.

BIOHAZARD

Dispose of the bent or damaged probe in accordance with your local or national guidelines for biohazard waste disposal.

2 Install the probe by following the procedure in *7.6.4.3 Installing Probe*.

CAUTION

Pull the probe to the above of wash pool after installing it and then load the sample/reagent disk.

7.6.6 Replacing Mixing Bar

If the mixing bar is damaged, it must be replaced immediately. Follow the procedure given below to replace the damaged mixing bar.

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

When replacing the bar, pinch the bar only by the knurled part and do not touch the other part of the bar. Protect the flat part of the bar from being scratched.

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles.

Dispose of the damaged mixing bar in accordance with your local or national guidelines for biohazard waste disposal.

CAUTION

Please use Mindray-recommended consumables. Other consumables may decrease the system performance.

1 Place the Power to OFF.

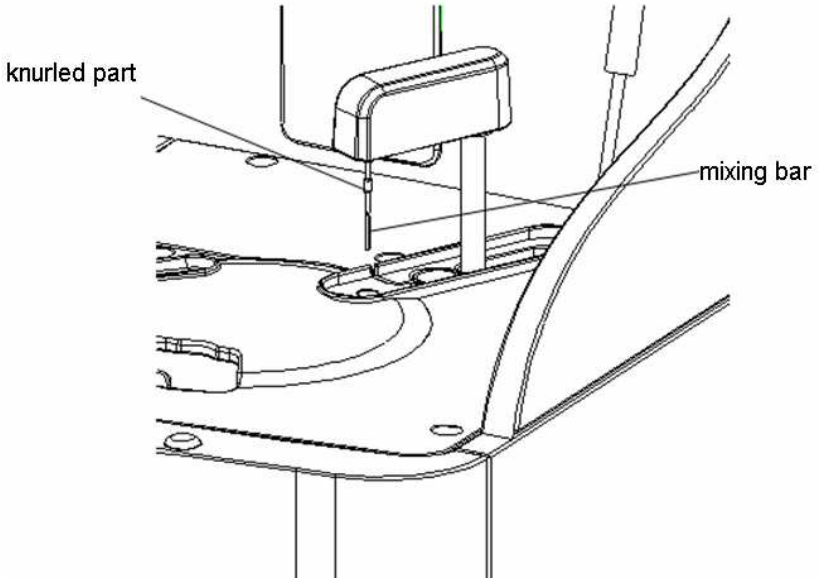
2 Gently pull the bar arm to a position convenient to operate.

3

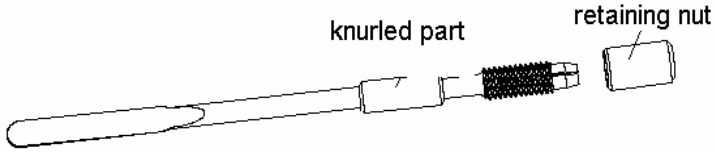
CAUTION

When trying to pull out the bar, concentrate your force in the direction of the axis on the bar arm. Biased force may damage the bar and/or the axis.

Pinch the bar by the knurled part with one hand and unscrew (counter-clockwise) the retaining nut with the other hand until the mixing bar looses. Pull the bar downward to remove it and remove the nut.



4 Align the new mixing bar to the bigger hole end of the retaining nut and gently screw it into the nut until the end of the bar is in line with the smaller hole end of the nut.



5 Pinch the mixing bar by the knurled part and align the hole of the nut to the axis on the bar arm, then push the bar upward in the direction of the axis until it can't proceed. Tighten the nut by screwing clockwise with the other hand.

CAUTION

When trying to pull out the bar, concentrate your force in the direction of the axis on the bar arm. Biased force may damage the bar and/or the axis.

Ensure the bar is all the way pushed to the end.

6 After replacing the bar, visually check whether the bar is vertical to the bar arm.

If not, remove the bar and re-install it.

If yes, proceed to the next step.

7 Pull the bar arm to its highest point and rotate it to move the bar to a position above its wash pool.

7.6.7 Replacing Plunger Assembly of Syringe

You should replace the old plunger assembly of syringe with a new one when,

- The old one has served for three months;
- The old one has been used for over 100,000 tests;
- The old one is apparently damaged.

WARNING

The probe tip is sharp and can cause puncture wounds. To prevent injury, exercise caution when working around the probe.

BIOHAZARD

In case your skin contacts the sample, control or calibrator, follow laboratory safety procedure and consult a doctor.

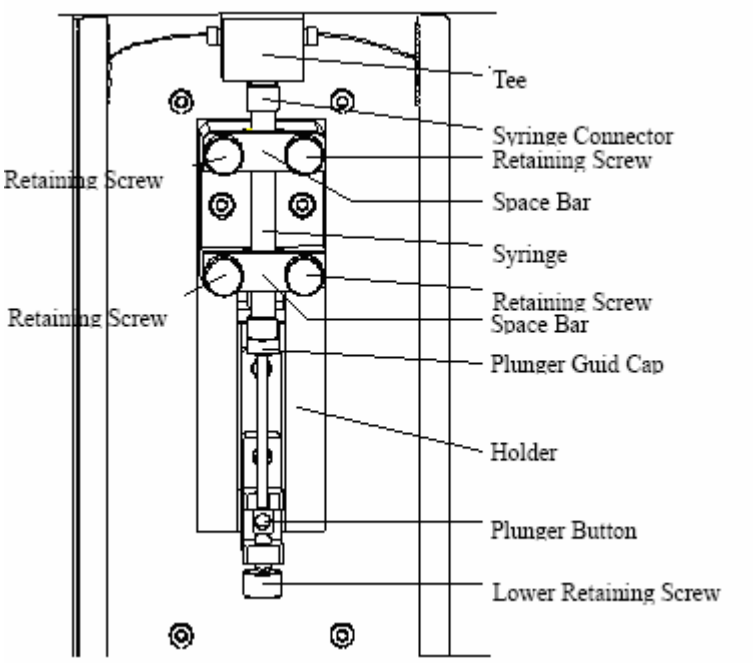
CAUTION

Please use Mindray-recommended consumables. Other consumables may decrease the system performance.

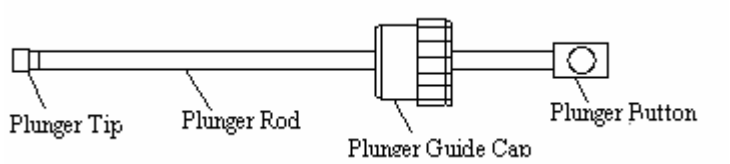
Exercise caution when installing the plunger assembly. Excessive force may crack the syringe.

1 Place the Power to OFF.

2 Unscrew the screws on the syringe cover and remove the cover. The structure of the syringe is as shown in the figure below.



3 Prepare a new plunger assembly (shown in the figure below) and soak the plunger tip in deionized water to eliminate bubbles.



4 Unscrew (counter-clockwise) the lower retaining screw.

5 Unscrew (counter-clockwise) the four retaining screws, remove the screws and space bars, and remove the syringe from the holder.

6

WARNING

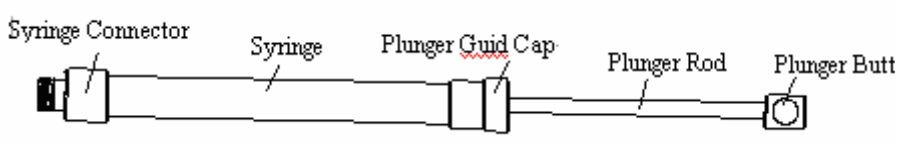
There may be residual water in the syringe connector. Do not drop water onto the analyzing unit.

Grab the Tee with one hand and the syringe connector with the other hand and unscrew (counter-clockwise) the syringe. Exercise caution so that the gasket on the syringe does not drop out and if it does, store it in a clean place for later installation.

NOTE

You should replace the gasket with a new one after removing and installing the syringe for about 2-3 times. Otherwise, sealingness of the fluidic path and sampling precision may be influenced.

7 Unscrew (counter-clockwise) the plunger guide cap and pinch the plunger button to gently pull the plunger assembly from the syringe.



8 Pinch the new plunger assembly by the plunger button and carefully insert the plunger tip into the syringe and push it all the way to the end. Screw (clockwise) the plunger guide cap until secure.

9 Immerse the syringe connector into deionized water. Pinch the plunger button, pull it to aspirate half syringe of deionized water and then push it to expel the deionized water and the air from the syringe.

10 Grab the Tee with one hand and the syringe connector with the other hand. Screw (clockwise) the syringe into the Tee until secure.

11 Place the syringe on the holder. Install space bars and fix the retaining screws.

CAUTION

The upper edge of the upper space bar must reach the seventh line of the scale on the syringe.

When fixing retaining screws, be sure to tighten them alternately with equilibrium force.

12 Screw (clockwise) the lower retaining screw until secure.

13 Place the Power back to ON.

14 Enter the ***Alignment*** screen of the operating software and set the ***Vol. (R. Syringe)*** to 450ul. Click ***R. Syringe Aspirate***. After the syringe finishes the motion, click ***R. Syringe Dispense***. You may repeat this action several times.

Pay attention to bubbles during the aspiration/dispensing process.

If there are bubbles observed during the process, they may be caused by the air leak between the syringe and the Tee. Uninstall the syringe and re-install it. If the bubbles are found again, please remove air bubbles referring to *7.6.8 Removing Air Bubbles* for details.

7.6.8 Removing Air Bubbles

When you see air bubbles in the syringe, follow this procedure to remove them.

BIOHAZARD

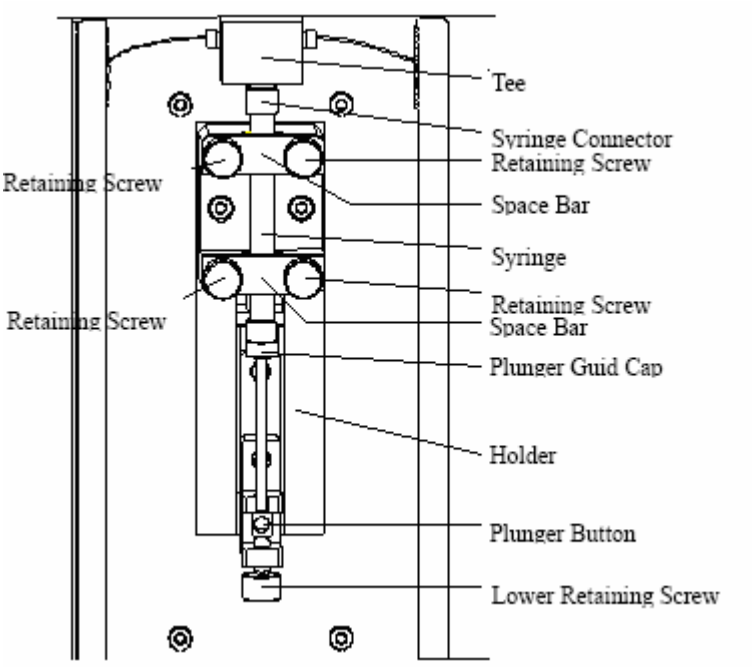
To prevent infection, always wear gloves, goggles and protective clothing when doing the maintenance.

Dispose of the waste in accordance with your local or national guidelines for biohazard waste disposal.

1 Place the Power to OFF.

2 Unscrew the screws on the syringe cover and remove the cover.

The structure of the syringe is as shown in the figure below.



3 Unscrew (counter-clockwise) the lower retaining screw.

4 Unscrew (counter-clockwise) the four retaining screws, remove the screws and space bars, and remove the syringe from the holder.

5 Pull the plunger gently outwards until you can not proceed any more, and then push it quickly. Repeat this pull-push operation until the air bubbles are removed from the syringe.

CAUTION

Be sure not to push the plunger to the end tip; otherwise the syringe may be damaged.

6 Place the syringe on the holder. Install space bars and fix retaining screws.

NOTE

The upper edge of the upper space bar must reach the seventh line of the scale on the syringe.

When fixing the retaining screws, be sure to tighten them alternately with equilibrium force.

7 Screw (clockwise) the lower retaining screw until secure.

7.6.9 Replacing Dust Screen

Replace the dust screen of poor ventilation after long time use. Please refer to 7.5.1 *Washing Dust Screen* for details.

7.6.10 Replacing Waste Tubing

If the waste tubing cannot discharge waste smoonthly after being used for a long time, replace it with the specified one.

7.7 Maintaining ISE Module (Optional)

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles.

Dispose of the waste part in accordance with your local or national guidelines for biohazard waste disposal.

CAUTION

Please use Mindray-recommended consumables. Other consumables may decrease the system performance.

NOTE

Run ISE calibration after the replacement of any following components.

7.7.1 Replace Reagent Pack

1 Place the Power to OFF.

2 Open the ISE unit door.

3 Remove and install a new reagent module.

4 Enter the ***ISE*** screen of the ***Maintenance*** of the system software.

5 Select ***Purge Combination*** from the Instructions list. Enter "25" in the edit boxes next to ***Purge A*** and ***Purge B*** in ***Parameters*** area, and then select ***Execute*** to start the purge cycle.

6 Execute ***Purge A Cycle*** and ***Purge B Cycle*** and check whether the initialization of the Reagent Pack is finished. If no error occurs during the process, the Reagent Pack is replaced successfully.

7.7.2 Replacing Electrodes

WARNING

Before performing the replacement, make sure the analyzer is powered off.

Replace the electrodes according to the following recommended schedule:

Na+ Electrode	Replace after 10,000 samples are tested
K+ Electrode	Replace after 10,000 samples are tested
Cl- Electrode	Replace after 10,000 samples are tested
Li+ Electrode	Replace after 3,000 samples are tested
Reference Electrode	Replace after 10,000 samples are tested

It is recommended to replace the electrodes after being used more than half a year.

NOTE:

The electrodes must be installed sequentially. You should take out the electrode to be replaced and those (or that) over it from above to below.

1 Enter the ***ISE*** screen of the ***Maintenance*** of the system software.

2 Select ***Maintenance Cycle*** from the Instructions list and select ***Execute***.

3 After exiting the system software, place the Power to OFF.

4 Open the ISE door on the left side of the analyzer.

5 Replace the electrodes.

6 Place the Power to ON.

7 Enter the ***ISE*** screen of the ***Maintenance*** of the system software.

8 Execute ***Purge A Cycle***. If no error occurs during the process, it means the electrode is replaced successfully.

9 Place the ISE door to its orginal place.

7.7.3 Replacing Tubing

Replace the tubing with specified one after long time use, if necessary.

7.7.4 Storage of ISE Module (Optional)

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles.

Dispose of the waste part in accordance with your local or national guidelines for biohazard waste disposal.

CAUTION

The maintenance is necessary to be performed when the ISE unit (optional) is connected.

When ISE module electrodes are installed, the power of ISE module should always be turned on. If the power has been turned off for more than 0.5 hour, please follow the instructions to store electrodes。

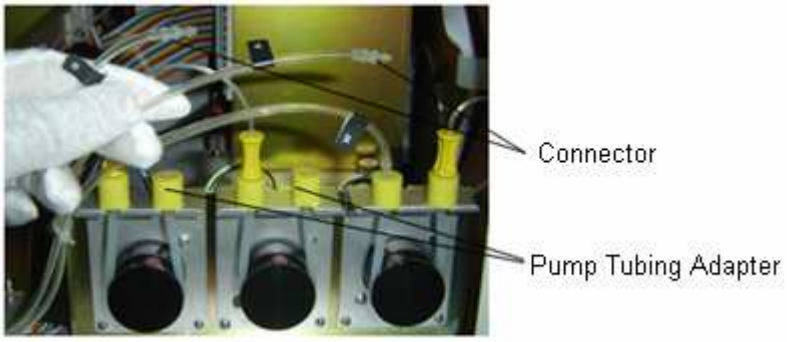
Please use Mindray-recommended consumables. Other consumables may decrease the system performance.

1 Enter the ***ISE*** screen of the ***Maintenance*** of the system software.

2 Select ***Clean Cycle*** from the ***Instructions*** list and select ***Execute***.

3 After exiting the system software, place the Power to OFF.

4 Pull out the joint A and joint B of the wand tubing which has been inserted into the adapters of the pump tubing. Hold them on for a few seconds until the solution in the wand tubing flows back to Reagent Pack.



5 Install the back panel of the analyzing unit and connect the power cable, serial port calble.

6 Place the Power to ON.

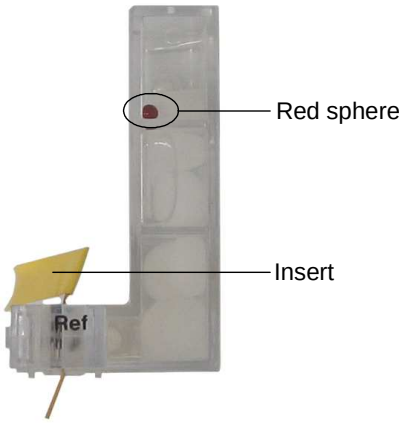
7 Select ***Purge Combination*** from the ***Instructions*** list, and enter digit “25” in the edit boxes to the right of ***Purge A*** and ***Purge B***. Select ***Execute*** to start the purge cycle based on the parameters you have entered.

8 Select ***Maintenance Cycle*** from the ***Instructions*** list and select ***Execute***.

9 Place the Power to OFF.

10 Remove the electrodes.

11 Seal the hole on the reference electrode with “insert” shown in the following figure.



12 Aspirate a small amount of Calibrant A from the port of the reagent module with a syringe and inject it into the lumens of the K+ electrode(and Li+ electrode) until the lumens are full.

Cover both ends of the lumens with tapes to prevent the Calibrant A flowing from the lumens.

Put the K+ electrode and Li+ electrode into their individual sealed bags.

13 Remove the reagent pack.

14 The tube adapters on Reagent Pack should be covered by the red caps. Store the Reagent Pack properly.

8 Test and Maintenance Software

8.1 Basic Operations

8.1.1 Installation

It is not necessary to install the test and maintenance software. Just copy the software files to the PC and click the NewDebug.exe icon to start the program. Parameters can be downloaded automatically when software is running. The communication frame is shown on the system interface when downloading the parameters. After downloading finished, you can use the functions of the software.

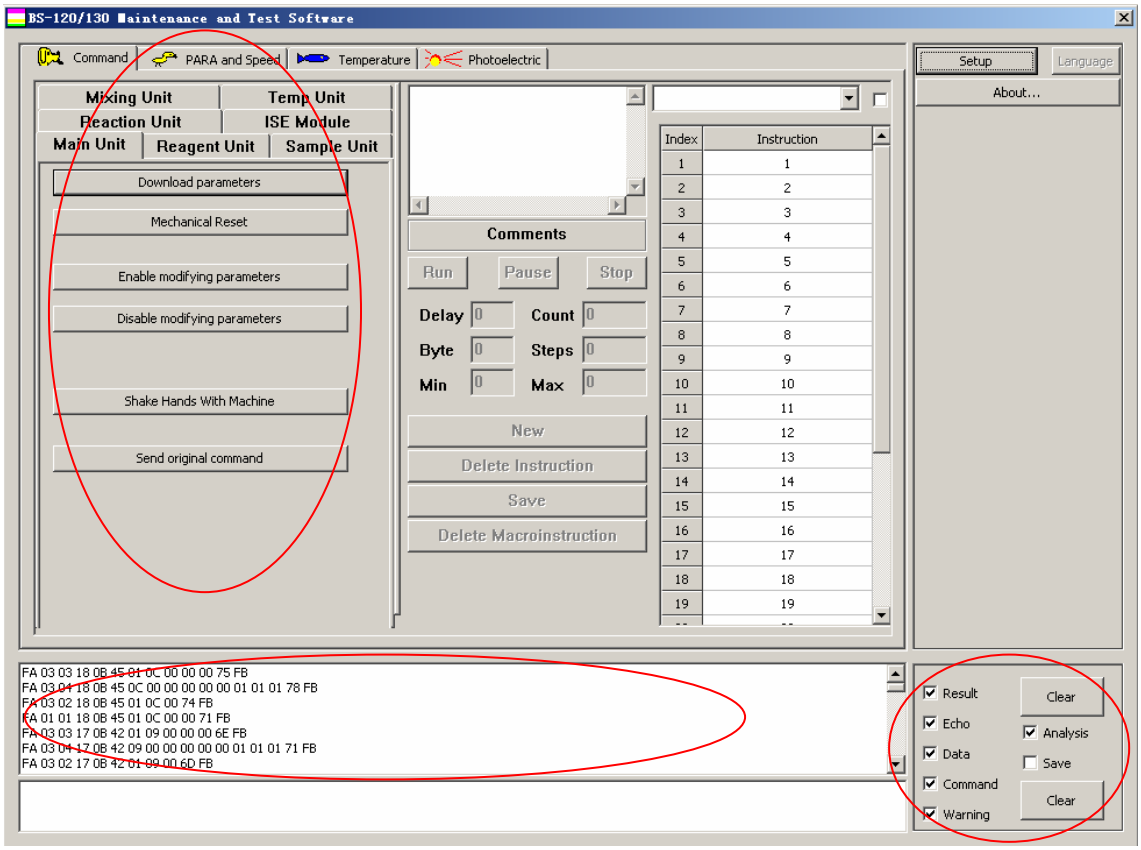
The product number of the test and maintenance software is G-BA10-30-78244 for BS-120/BS-130 and G-110-000519-00 for BS-180/BS-190.

8.1.2 Overview

8.1.2.1 Screen Layout

The main screen of the test and maintenance software consists of two parts. See Figure 8-1.

Figure 8-1 Screen layout of Test and Maintenance Software



The upper area provides various function buttons to test each unit.

The lower area displays the communication data associated with the main unit/subunits. The lower-right area provides options and buttons to control the communication frame.

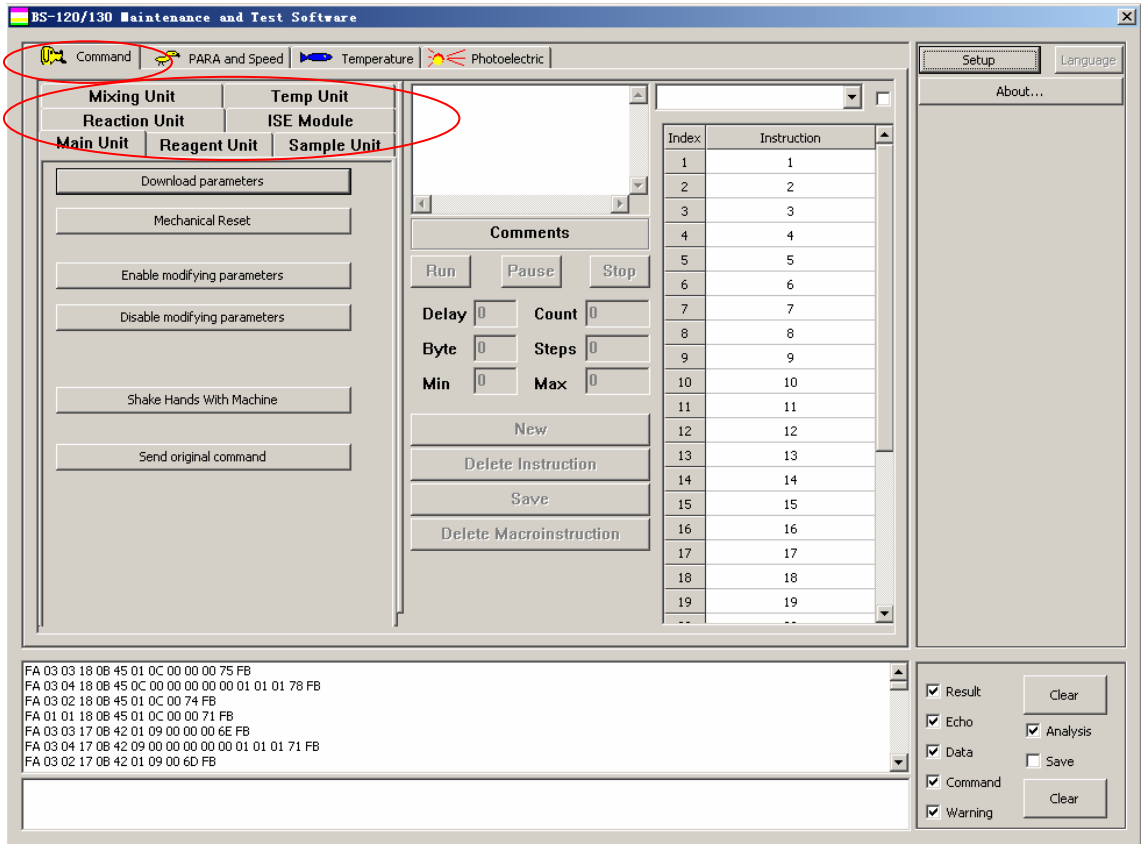
8.1.2.2 Function Distribution

Click ***Command*** on the higher-left area as shown in Figure 8-2. At the ***Command*** screen，you can select different units and then you can see the debugging buttons of the corresponding units.

Similarly, you can choose ***PARA and Speed***, ***Temperature***, ***Photoelectric*** on the higher-left area to run different debugging functions.The following is an introduction of the ***Command***, ***PARA and Speed***, ***Temperature***, ***Photoelectric***.

The function buttons for serial port setup, version query are located on the higher-right area of the main interface.

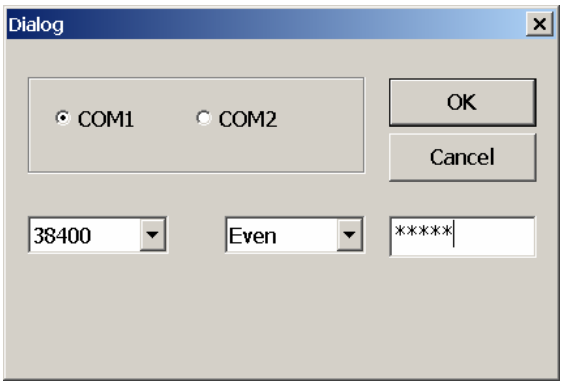
Figure 8-2 Screen Layout of Test and Maintenance Software



8.1.2.3 Language Switch

The software support English and Chinese display. After opening the software, click ***setup*** on the higher-left area and input “bs120” in textbox of the pupped-up dialog box (see Figure 8-3), and then click ***ok***. As long as the ***Language*** button is selectable, click it to change the language.

Figure 8-3 Input Serial Port Password



8.2 Operating Commands

Click ***Command*** on the higher-left as shown in Figure 8-2, and then you can see the tabs for each unit.

8.2.1 Main Unit

The ***Main Unit*** screen includes the following commands:

- ***Download Parameters***: Download parameters for all of units.
- ***Mechanical reset:*** Select this command to reset the mechanical parts of subunits.
- ***Enable modifying parameters***: Select this command to enable modifying the parameters of all units.
- ***Disable modifying parameters***: Select this command to disable modifying the parameters of all units.
- ***Shake Hands With Machine***: Select this command to communicate with the main unit.

NOTE

Enable modify parameters and ***Disable modify parameters*** can be used only when the parameter write protection of the main board is disabled.The main board will be at the status of parameter write protection in normal situation. Please refer to ***8.3.1*** for details about how to cancel parameter write protection.

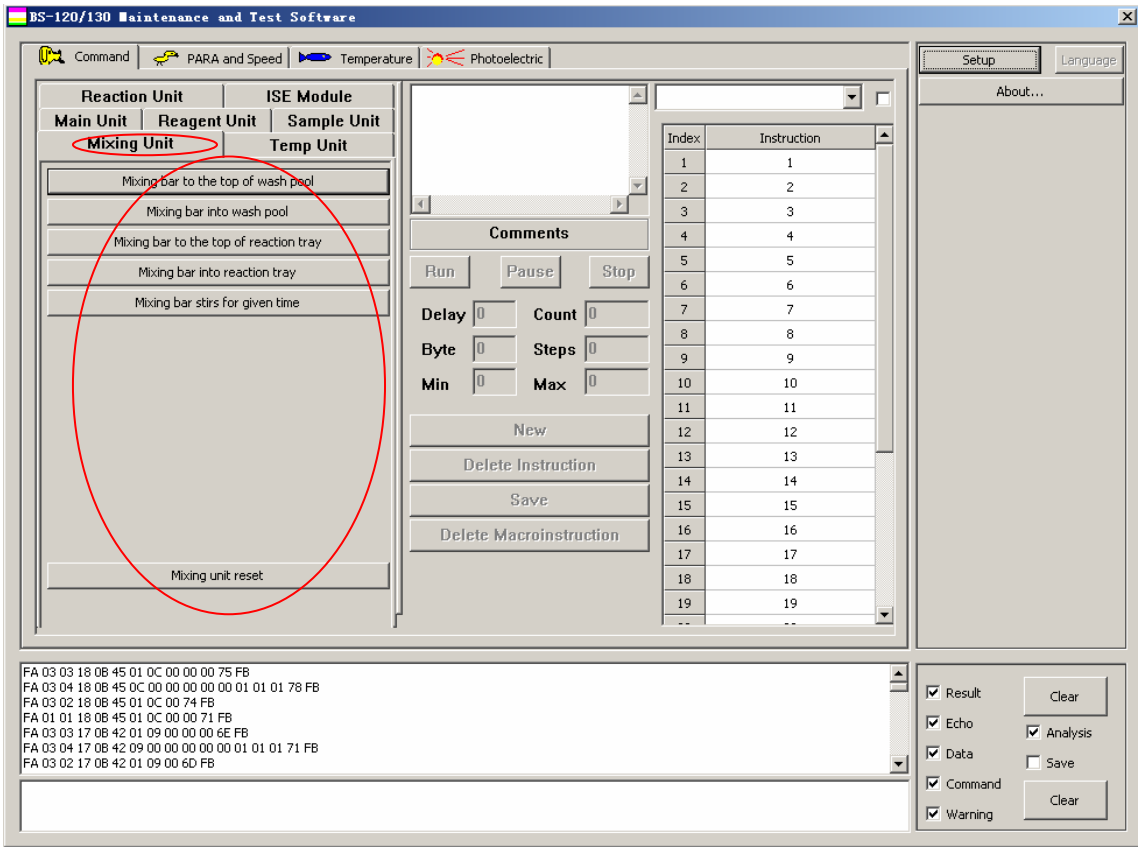
- ***Send original command***: Select this command to send the instruction to the main unit directly. Please note that this function can be performed only by debug users.

8.2.2 Mixing Unit

Click ***Mixing Unit*** on the higher-left area and then you can see the fuction buttons of the mixing unit.

- ***Mixing bar to the top of wash pool***——Move the mixing bar to the position above the wash pool
- ***Mixing bar into wash pool***——Move the mixing bar into the wash pool to wash
- ***Mixing bar to the top of reaction tray***—— move the mixing bar to the position above the reaction tray
- ***Mixing bar into reaction tray***——Move the mixing bar down into the reaction tray
- ***Mixing bar stirs for given time***——Turn on the motor and the mixing bar stirs for given time
- ***Mixing unit reset***——Execute mechanical resetting to the mixing unit. The mixing bar moves to the top of the reaction tray from the current position and then back to the wash pool to wash.

Figure 8-4 Mixing Unit Debugging Interface



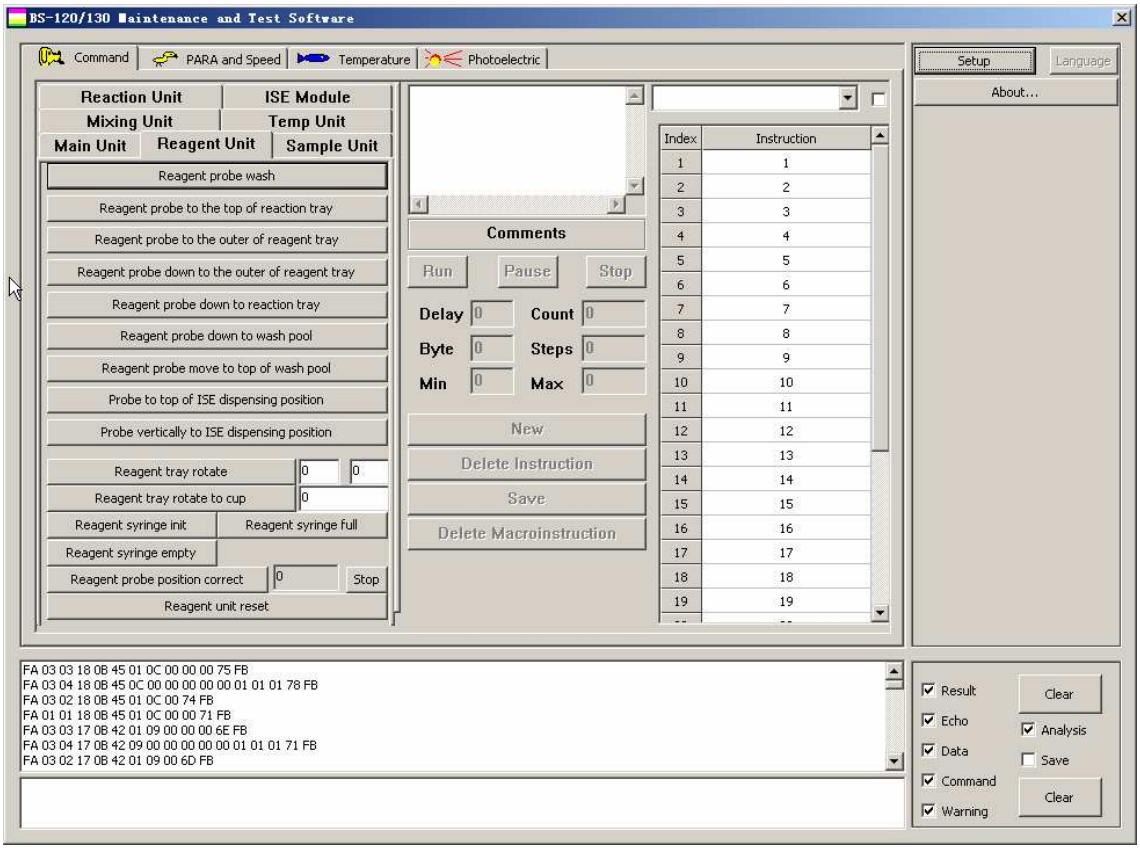
8.2.3 Reagent Unit

Click ***Reagent Unit*** on the higher-left area and then you can see the function buttons of the reagent unit. For ***Reagent tray rotate***, input the number of circles to rotate in the first edit box, and the specified position to stop in the second edit box. The specified position means specified bottle to aspirate.

The ***Reagent probe postion correct*** and ***Stop*** are reserved functions, but not available in the current version.

Like other units, the actual working postion of the sample unit and reagent unit is determined by their respective position parameters. Please refer to 8.3 for details about parameters.

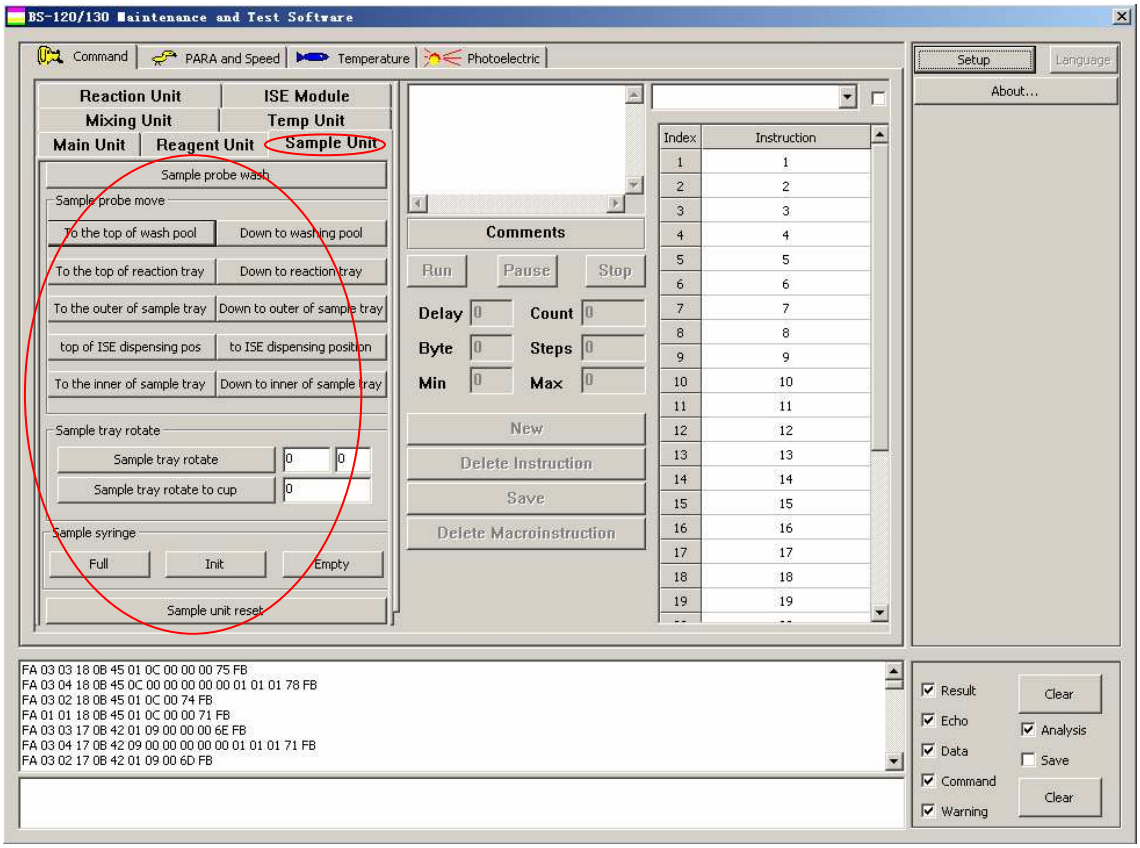
Figure 8-5 Reagent Unit Debugging Interface



8.2.4 Sample Unit

Since the sample unit and the reagent unit share the same probe and sample/reagent disk, the debugging functions for the sample unit and reagent unit are the same.

Figure 8-6 Sample Unit Debugging Interface



8.2.5 Reaction Unit

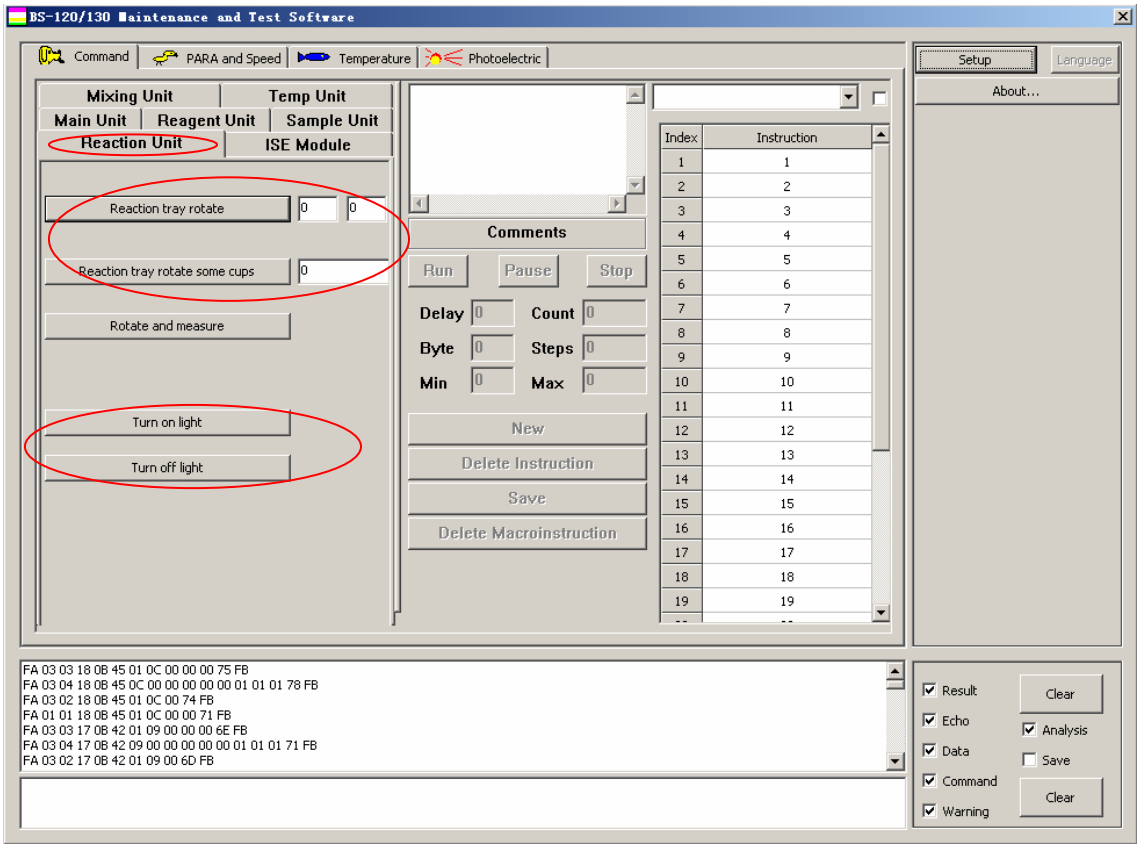
Click ***Reaction Unit*** on the higher-left area and then you can see the fuction buttons of the reaction unit.

- ***Reaction tray rotate***——Input the number of the circles to rotate in the first edit box and the position to stop in the second edit box, which means to stop the specified cuvette to the 1# dispensing position of the reaction disk.

When you input “29” into the second edit box, the first cuvette segment will stop at the replacement position; input “34”, the second cuvette segment will stop at the replacement position; input “39”, the third cuvette segment will stop at the replacement position; input “4”, the fourth cuvette segment will stop at the replacement position…and the rest cuvette segment can be deduced by analogy.

- ***Reaction tray rotate some cups***——The number of cuvettes the reaction disk passes while rotating.
- ***Turn on light***
- ***Turn off light***
- ***Rotate and measure***—— Collect photoelectric data of all the cuvettes on the reation disk at all wavelengths.

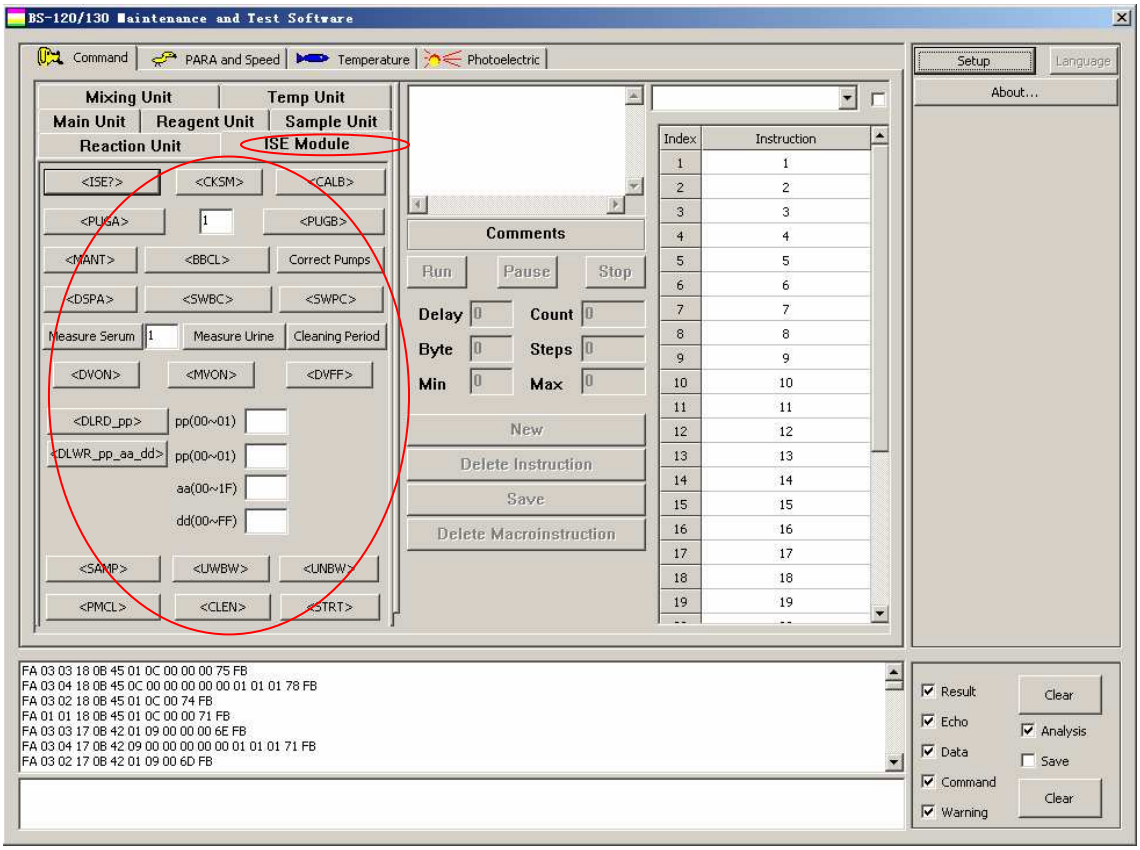
Figure 8-7 Reaction Unit Debugging Interface



8.2.6 ISE Module

Click ***ISE Module*** on the higher-left area and then you can see the fuction buttons of the ISE module.

Figure 8-8 ISE Module



The following is the introduction of the sending instruction and the returning instruction.

- Handshake: shake hands with ISE module.Sending instruction: <ISE?>, returning instruction <ISE!>
- Purge A: Purge A cleaning. Sending instruction: <PUGA>
- Purge B: Purge B cleaning. Sending instruction: <PUGB>
- Bubble calibration: Sending instruction <BBCL>, returning instruction <BBC A xxx M xxx L xxx>
- Calibration: sending instruction <CALB>, returning instruction <CAL Li xx.xx Na xx.xx K xx.xx Cl xx.xx eeeeeeec> <CAL Li xx.xx Na xx.xx K xx.xx Cl xx.xx eeeeeeec>
- Maintenance: Sending instruction: <MANT>, returning instruction <ISE!>
- Single step serum: Sending instruction: <SAMP>, returning instruction <ISE!>
- Single step urine 1: Sending instruction: <UWBW>, returning instruction <ISE!>
- Single step urine 2: Sending instruction: <UWBW>, returning instruction <ISE!>
- Single step wash: Sending instruction: <CLEN>, returning instruction <ISE!>
- Single step pump calibration: Sending instruction: <PMCL>, returning instruction <ISE!>
- Single step start: Sending instruction: <STRT>, returning instruction /
- Dispense purge A: Sending instruction: <DSPA_200>, returning instruction <ISE!>

- Debugging start 1: Sending instruction: <DVON>, returning instruction <ISE!>
- Debugging start 2: Sending instruction: <MVON>, returning instruction <ISE!>
- Debugging shutdown: Sending instruction: <DVFF>, returning instruction <ISE!>
- Program check: Sending instruction: <CKSM>, returning instruction <ISV cccc>
- Read electrode output voltage: Sending instruction: <RDMV>, returning instruction <AMV Li xxx.x Na xxx.x K xxx.x Cl xxx.x>
- Read reagent chip: Sending instruction: <DLRD_pp>, returning instruction <DSN s0s0s1s1……..s6s6s7s7 c>
- Write reagent chip: Sending instruction: <DLWR_pp_aa_dd>

8.2.7 Temperature Unit

Click ***Temp Unit*** on the higher-left area and then you can see the fuction buttons of the reaction unit.

Select the ***Reaction*** checkbox, and then click ***Enable/Disable temperature control*** to turn on the reaction disk temperature control. Disselect the ***Reaction*** checkbox, and then click ***Enable/Disable temperature control*** to turn off the reaction temperature control.

Reagent PreHeat is to control the reagent preheating. The control method is the same with ***Reaction***.

Length of Sensor Line: orginal line- 3.5cm extra line- 51.5 cm. Both are fixed parameters.

Orginal Data: Input 0, 37 and 100 to the T column, and corresponding resistance values in the R column. Click ***Caculate*** to get R0, A, B.

When the reaction disk temperature sensor is replaced, the R0, A, B should be recalculated by using the function provided by ***Orginal Data***. The R0, A, B should be configured in ***PARA and Speed-Temperature Unit***.

When temperature collection board is replaced, ⊿AD should be reconfigured in ***PARA and Speed-Temperature Unit***.

The interface to configure temperature control parameters is shown in the Figure 8-10.

Reagent preheating sensor: keep the default.

Reaction disk sensor: input the calculated R0, A, B in the first three column; input ⊿AD value in the fourth column (found in the temperature collection board. If the board is not replaced, leave it unmodified.)

Target temp. of reaction disk[0.01℃]: keep 37.8 as default.

Reagent preheating temp. control: keep 12/10/2 as default.

Target temp. for reagent preheating: keep 45 as default.

Reaction temp. control: keep 100/250/50 as default.

Figure 8-9 Temperature Unit

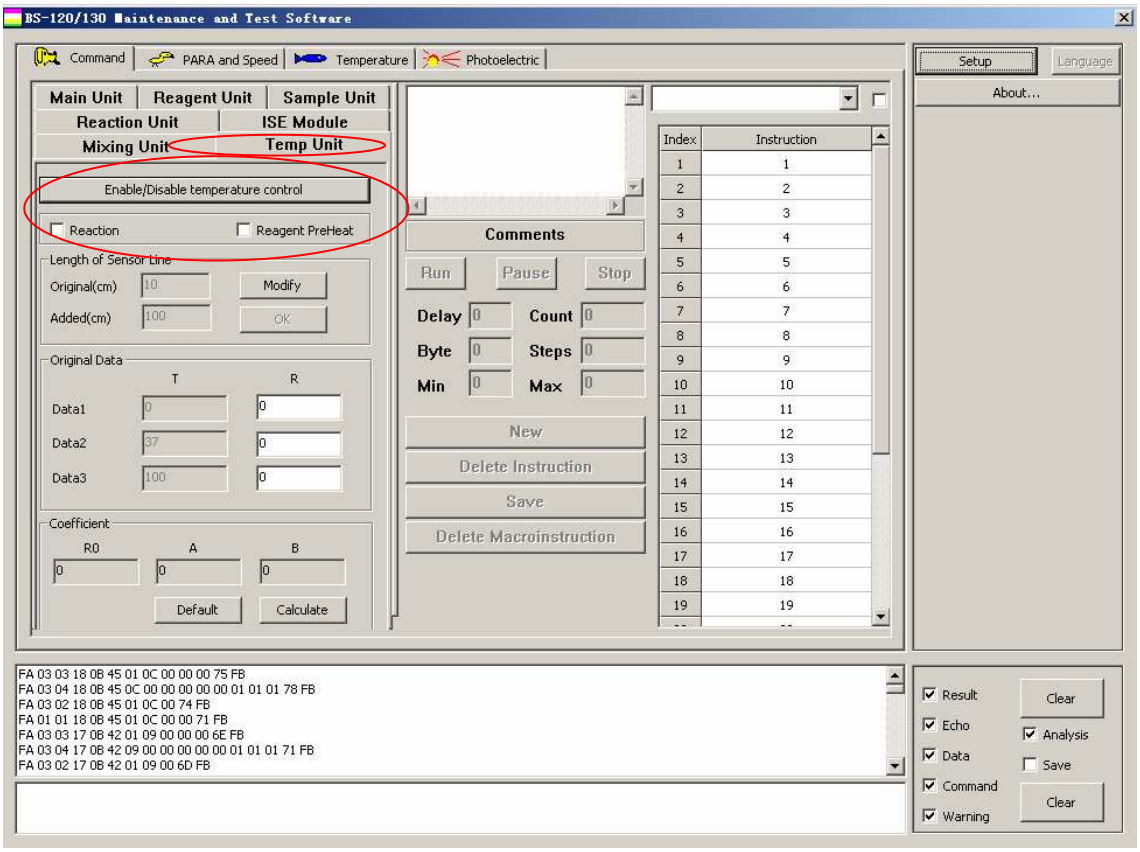
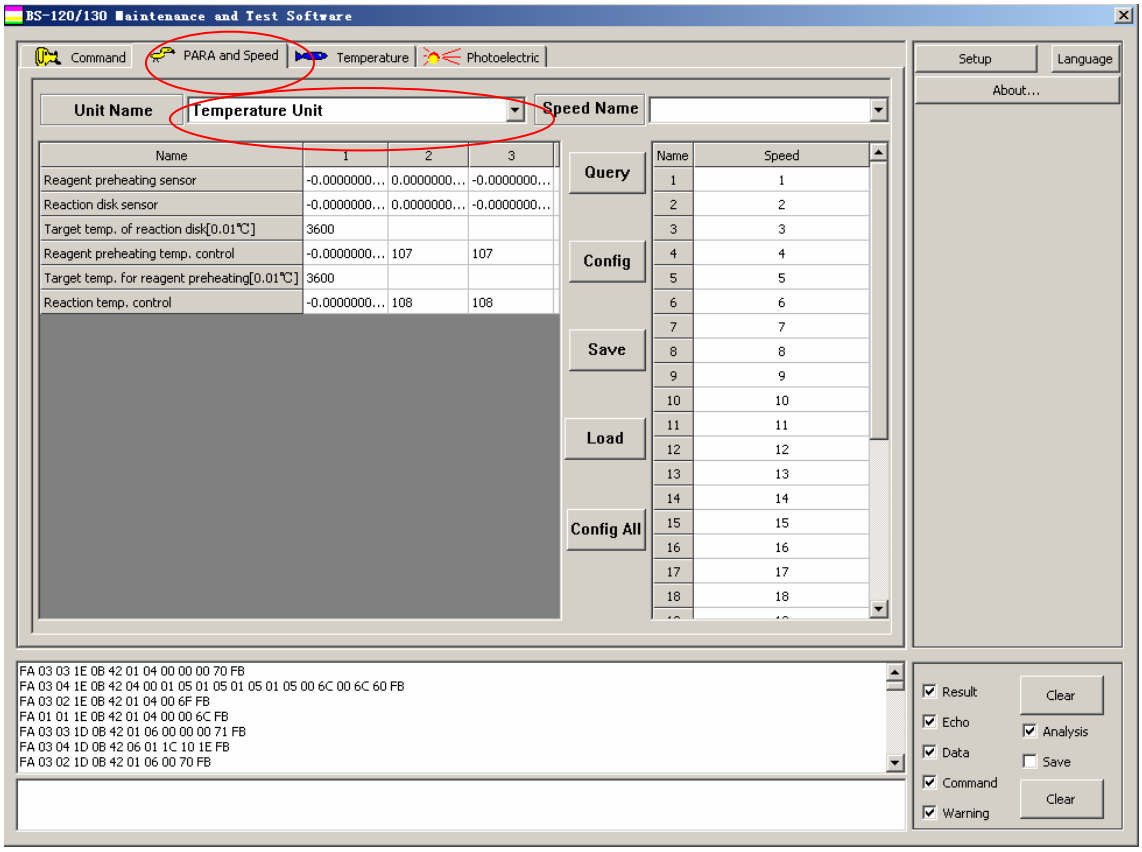


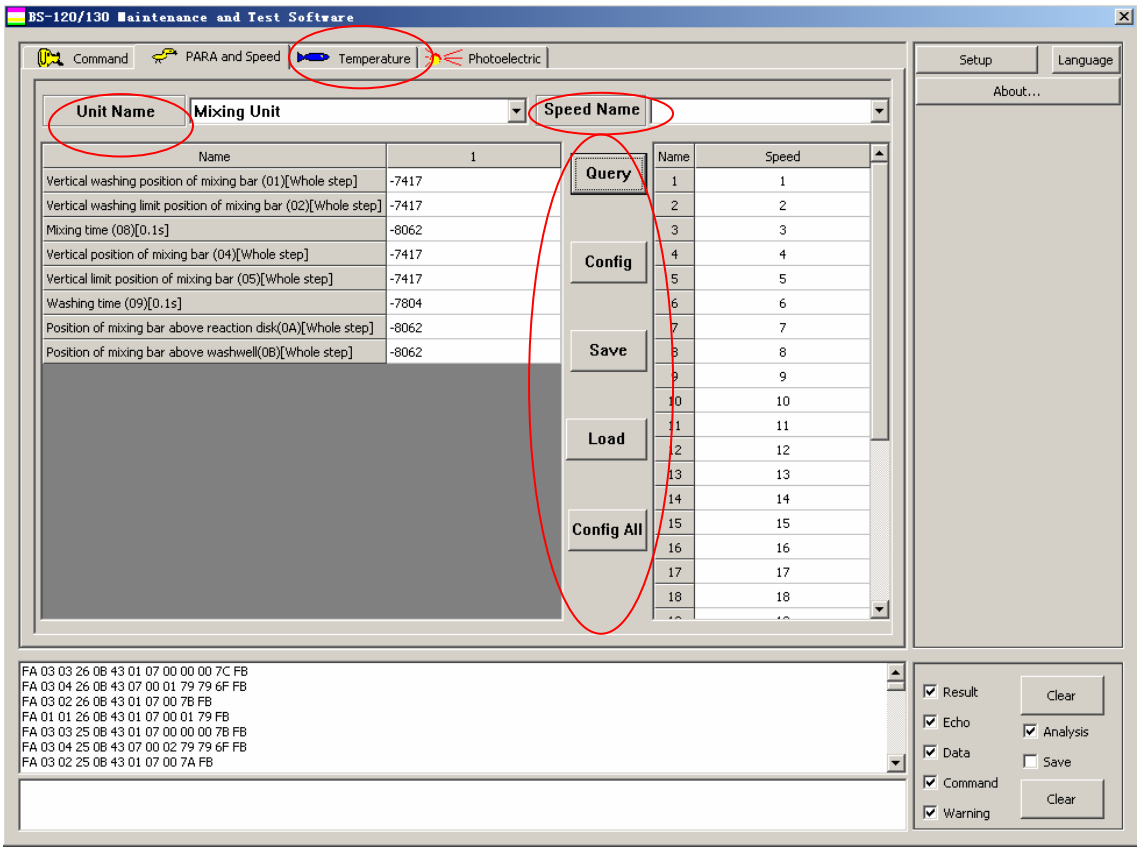
Figure 8-10 Temperature Unit Parameter Configuration



8.3 Parameter

Select ***PARA and Speed*** on the higher-left area to enter the parameter configuration screen shown in Figure 8-11.You can configure two types of parameters: the parameters of the subunits and the parameters of the motor speed.To configure the parameters of the subunits, select the unit from the ***Unit Name*** drop-down list. To configure the motor parameters, select the motor from ***Speed Name*** drop-down list.

Figure 8-11 Parameter Configuration Interface



8.3.1 The Precondition for Parameter Configuration

Enable the parameter modification before configuring the parameters.

To save the modification, follow the instruction below:

Connect socket J15 on main board as shown in Figure 8-12. The parameter modification function is then enabled.The default connection is shown in figure 8-12 (a). It is in parameter write protection.

Figure 8-12 Connection Mode of the J15 Socket on Main Board

（a）parameter write protection　　（b）parameter modification enabled

Select ***Enable modifying parameters*** on ***Command-Main Unit*** of the test and maintenance software and then configure the parameters and save the modification.

After configuration, restore the main board to the status of parameter write protection.

NOTE

If not necessary, please do not use this method to modify parameters.

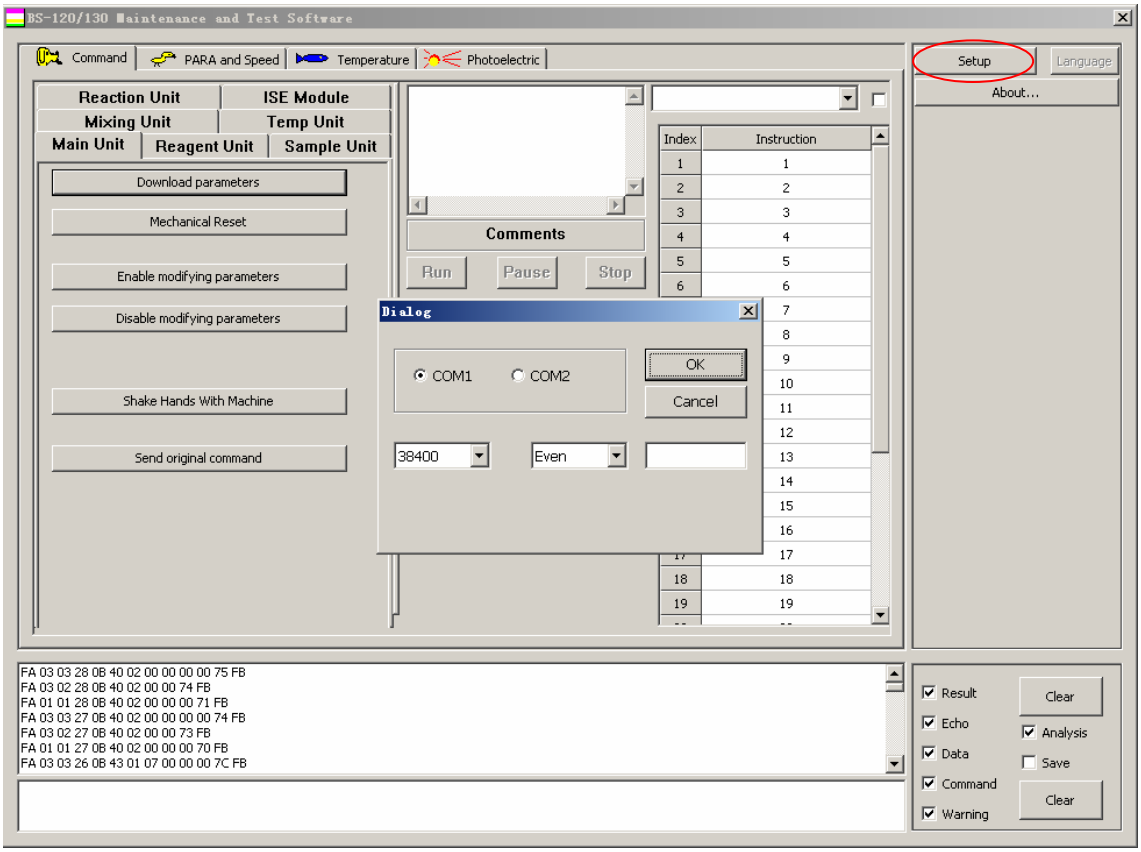
If really necessary, restart the analyzing unit and double check to confirm the modification of the parameter after configuration,

After the parameter configuration is validated, restore the socket J15 on main board to the status of parameter write protection.

If it is not necessary to validate the modified parameters perpetually, you can restore the previous parameters after restarting. Please follow the instructions as below:

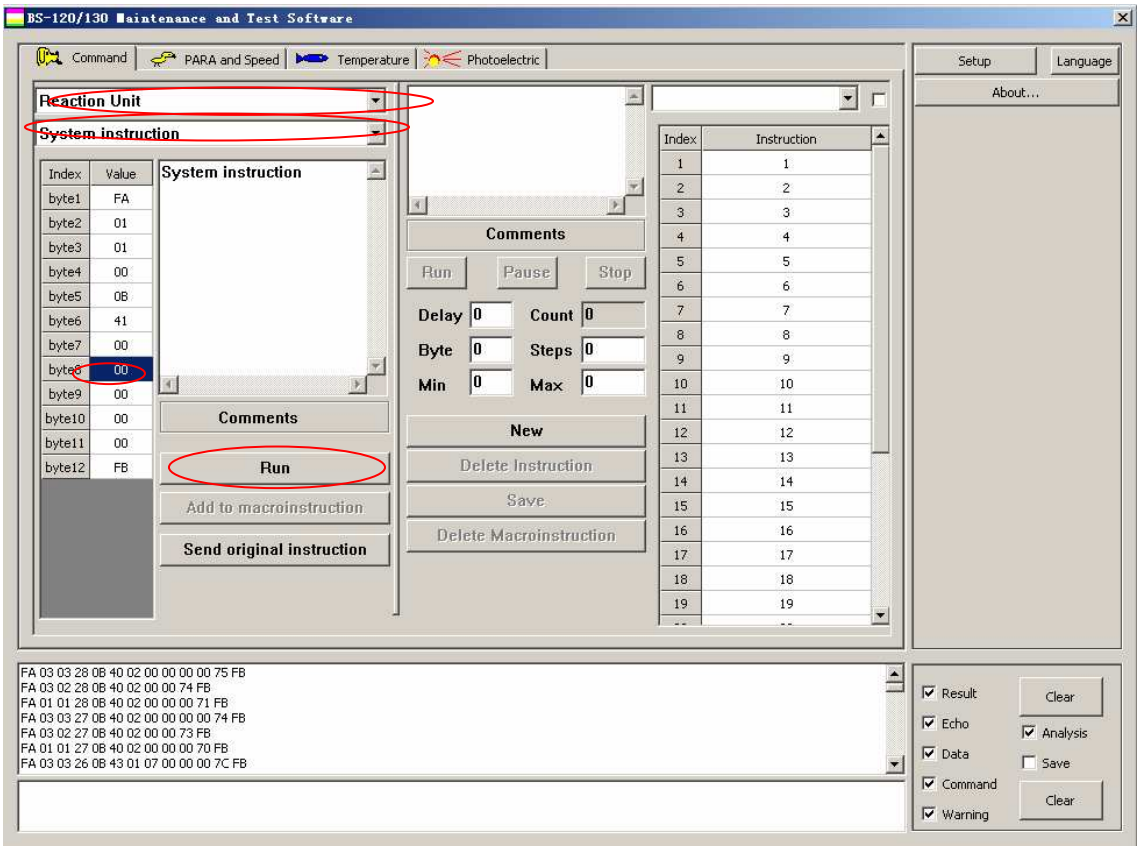
Click the ***Setup*** button on the higher-right area of the software shown in Figure 8-13, input bs120 to the dialog box, and then click ***OK***.

Figure 8-13 Enable Modifying Parameters 1



2) There is ***System instruction*** under each unit name. Please change the value of ***byte 8*** from 00 to 03 in the ***system instruction***, and then click ***Run*** to validate the configuration. The following figure takes the reaction unit as an example.

Figure 8-14 Enable Modifying Parameters 2



NOTE

1、 The configuration modification is only effective to selected unit.If the number of the units is more than 1, modify configuration of each unit respectively.

2、 If the main board is in the status of parameter write protection, you can still use the method to modify parameter configuration, but the parameters will be restored to the previous one after restarting.

3、 If the main board is not in the status of parameter write protection, the modification will be validated perpetually.

8.3.2 Detailed Operations

The operation units related to the parameters include ***Inquire***, ***Configure***, ***Save***, ***Read*** and ***Configure All***. Enable the parameter modification before configuring the parameters, The detailed operations are described in the section *8.3.1*

Before performing the operation, select the target unit from the drop-down list of “Unit Name” or “Speed Name”. If a unit from the Unit Name list and a motor from the Speed Name list are both selected, the system can only identify the last selected one.

8.3.2.1 Query

Select the target unit and click ***Query*** to inquire about the parameters of the corresponding units and the motors.

8.3.2.2 Config

1. Inquire or read the parameters of the selected unit.
2. Modify the parameter
3. Enable the parameters to be selectable and then click ***Config.***
4. The parameter configuration will be completed, only when the Config command frame (the third byte of the communication frame is 01), Reply frame (the third byte of the communication frame is 02) and the result frame (the third byte of the communication frame is 03) show up.
5. After parameter configuration, click Query to confirm.

The parameter configuration will be successful only when the parameter modification of the target unit is enabled. Otherwise, the warning of parameter modification protection will show up at the bottom of the screen.

For the units in the Unit Name drop-down list, if the main board is in parameter write protection status, the new parameters will be validated after configuration; but the system will restore the previous parameters after restarting. If the modification function is enabled, the new parameters will be perpetually validated after configuration.

For the motors in the Speed Name list, the configuration modification will only be validated after configuration. After the analyzing unit is shutdown, the motor parameters will be stored to the original ones.

8.3.2.3 Save

Click **Save** to back-up the current parameters of the target unit in a new file after the operations of ***Inquire***, ***Configure***, ***Read*** and ***Configure All***.

8.3.2.4 Load

1）Select a target unit.

2）Click ***Read*** and then select a parameter file in the pop-up dialog box. If the selected file is not belong to the target unit, the system will automatically switch the current unit to the unit specified by the parameter file.

3) Click ***Config All*** to refresh all the parameters of the target unit.

8.3.2.5 Config All

1) Select a target unit.

2) Inquire or read the parameters of the selected unit, or modify the parameter if needed.

3) Select ***Confiure All*** to complete the configuration with all current parameters to the target unit.

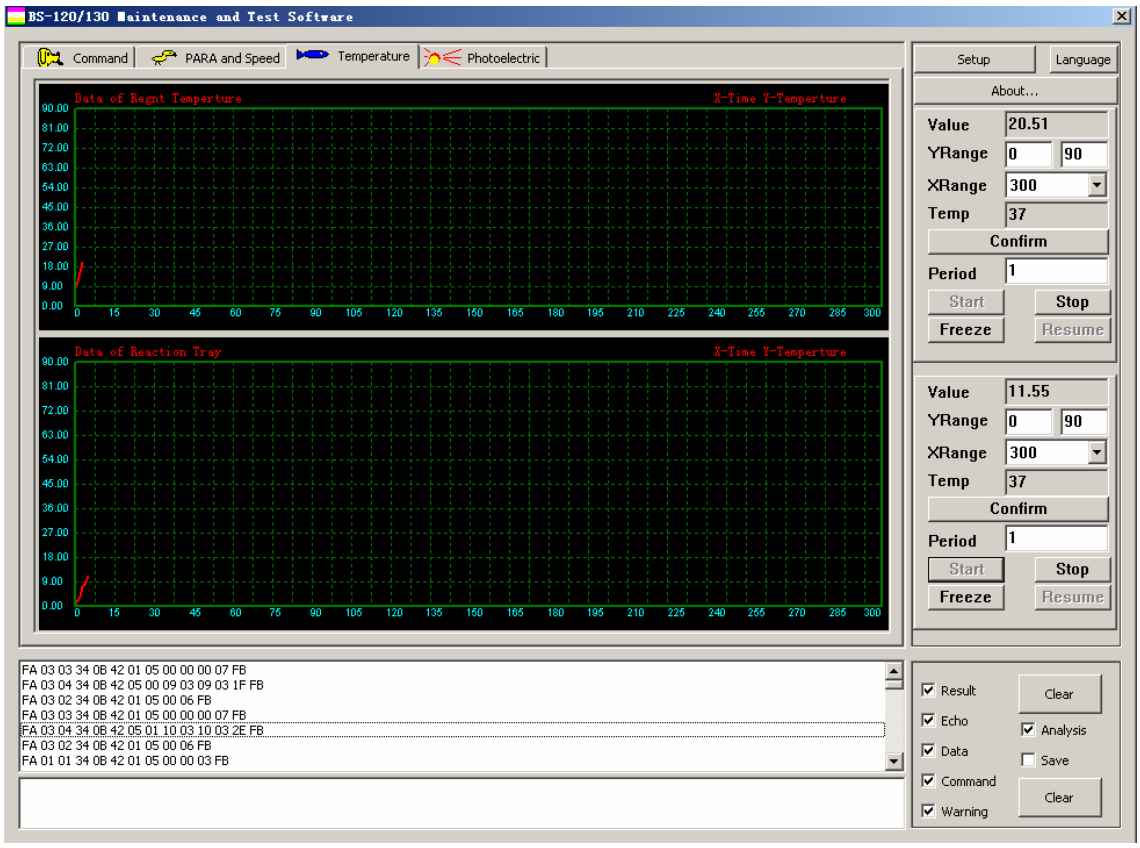
8.4Temperature

8.4.1 Functions

The ***Temperature*** provides the functions of real-time monitoring on the temperature of the reaction disk and the reagent preheating.

8.4.2 Operation Details

Figure 8-15 Reaction Disk and Reagent Preheat



This following content discribes the functions on the ***Temperature*** screen.

Value: current temperature

YRange: set up the Y coordinate range

XRange: set up the points on the X coordinate

Period: set up the interval of sampling. The unit is second.

Stop: stop temperature data collection

Freeze: stop refreshing the curve

Click ***Start*** to begin the collection of temperature data.

You can adjust the YRange during collection.

The startup temperature will be saved automatically under the running directory.

The operation to monitor the temperature curve of reagent preheating is the same as

reaction disk.

8.5 Photoelectric

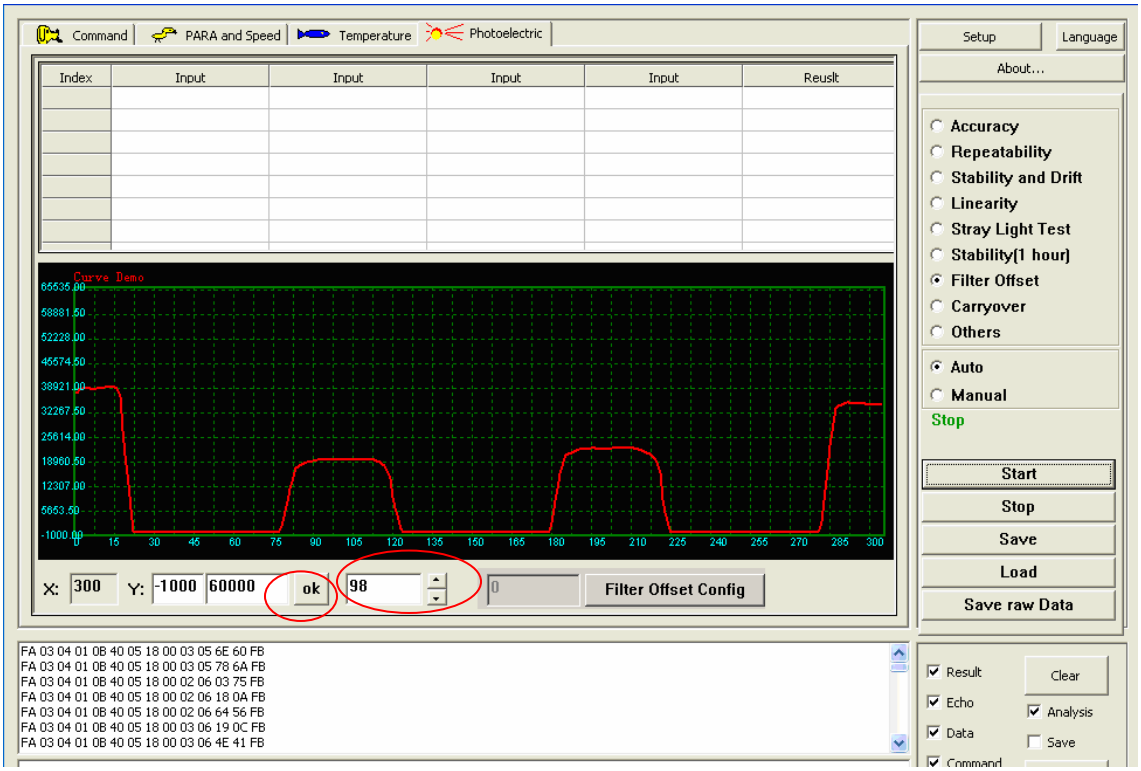
The following operations are performed on the ***photoelectric*** screen:

1) Filter offset test;
2) Photoelectric gain auto-configuration;
3) Light source background test;
4) Dark current test.

8.5.1 Filter Offset

1) Select ***Photoelectric***-***Filter Offset***, and then click ***Start***.
2) The process will last for 3-4 minutes until all the red curves are displayed. The green font appears to indicate the test is finished.
3) After testing, click ***OK***. A pink line will be at the center of the first peak.You can also adjust the line manually by clicking the up-arrow and the down-arrow on the text box under the curve.
4) When the line is adjusted to the center of the first peak, the offset of the filter equals to the value in the text box minus 100.
5) Confiugure the filter offset in ***PARA and Speed***-***Reaction Unit***.

Figure 8-16 Filter Offset



8.5.2 Photoelectric Gain

NOTE

Before configuring the gain, make sure the filter offset has been reasonably configured.

1) After start-up and the light source is stable, select ***Photoelectric-Others-Test Gain*** and then click ***Start***.

2) After the test is finished, you can view the gain value in the ***Gain*** column.The order is 340nm, 405nm, 450nm, 510nm, 546nm, 578nm, 630nm, 670nm.

3) During the test, the software will configure the gain value to the reaction unit.

4) After the test, you can select ***PARA and Speed-Reaction Unit-Query*** to confirm the configuration.

Note: the order of the gain on the reaction unit is opposite to the order mentioned above. The order on the reaction unit is 670nm, 630nm, 578nm, 546nm, 510nm, 450nm, 405nm, 340nm.

5) Run background test to confirm the gain configuration.The recommended range for background is 48000-62000.

6) If the gain values of a channel are not reasonable, adjust them manually. Change the gain value of the specific channel on ***PARA and Speed-Reaction Unit.*** You will get low background value by configuring large gain value. Similarly, you will get high background value by configuring low gain value. The input range for gain value is 1-255.

NOTE

During the test, the software will configure the gain parameters of the reaction unit. Therefore, enable the parameter modification function of the reaction disk before testing.

NOTE

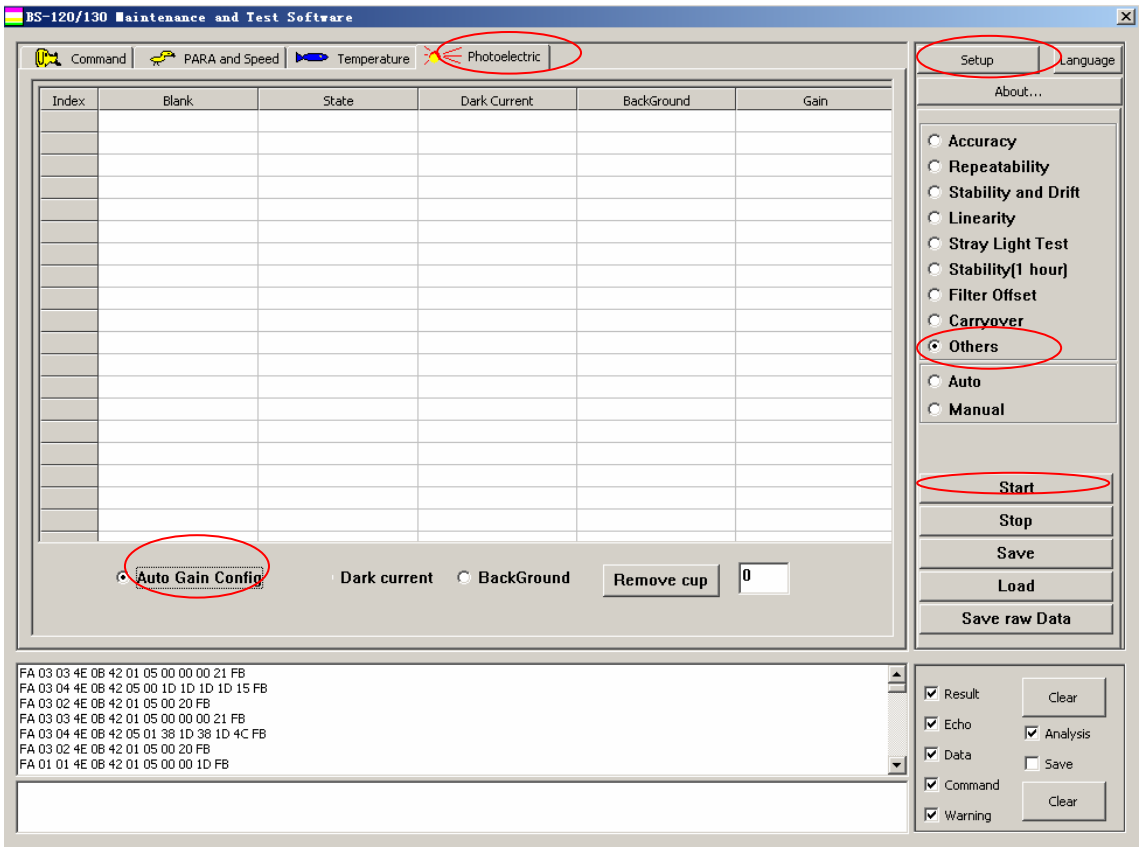
Run background test after configuration to confirm the configuration. The recommended range for background is 48000-62000.

CAUTION

It is only necessary to run gain test after replacing the lamp and the background overflows (exceeding 65535). Do not adjust the gain to elevate the background.

Otherwise the performance will be affected.

Figure 8-17 Gain Test



8.5.3 Light Source Background

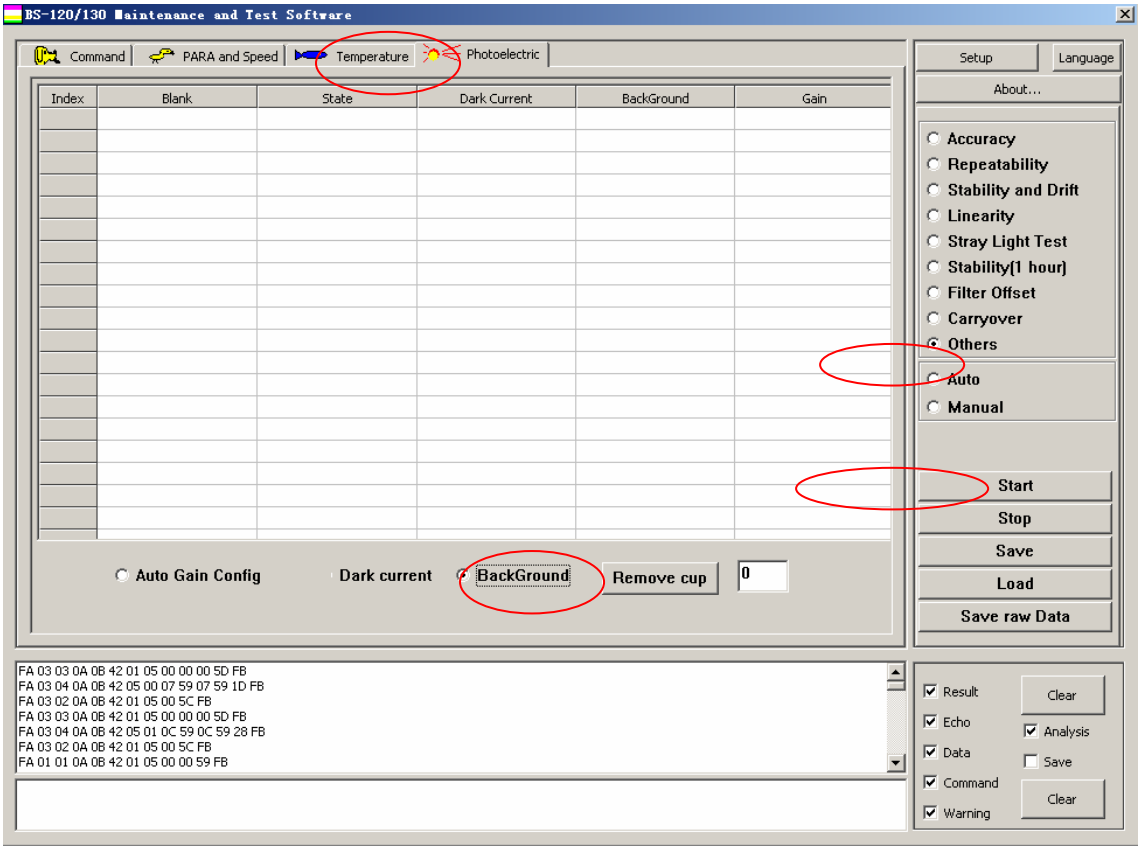
Run background test when it is necessary to confirm the intensity of the light source or to confirm the gain configuration.

1) After start-up and the light source is stable, select ***Photoelectric-Others-Light Base*** and then click ***Start***.

2) When the green font above ***Start*** appears, remove the current cuvette segment and then click ***Start***.

3) When the test is finished, you can view the background on ***BackGround*** column. The order is 340nm, 405nm, 450nm, 510nm, 546nm, 578nm, 630nm, 670nm.

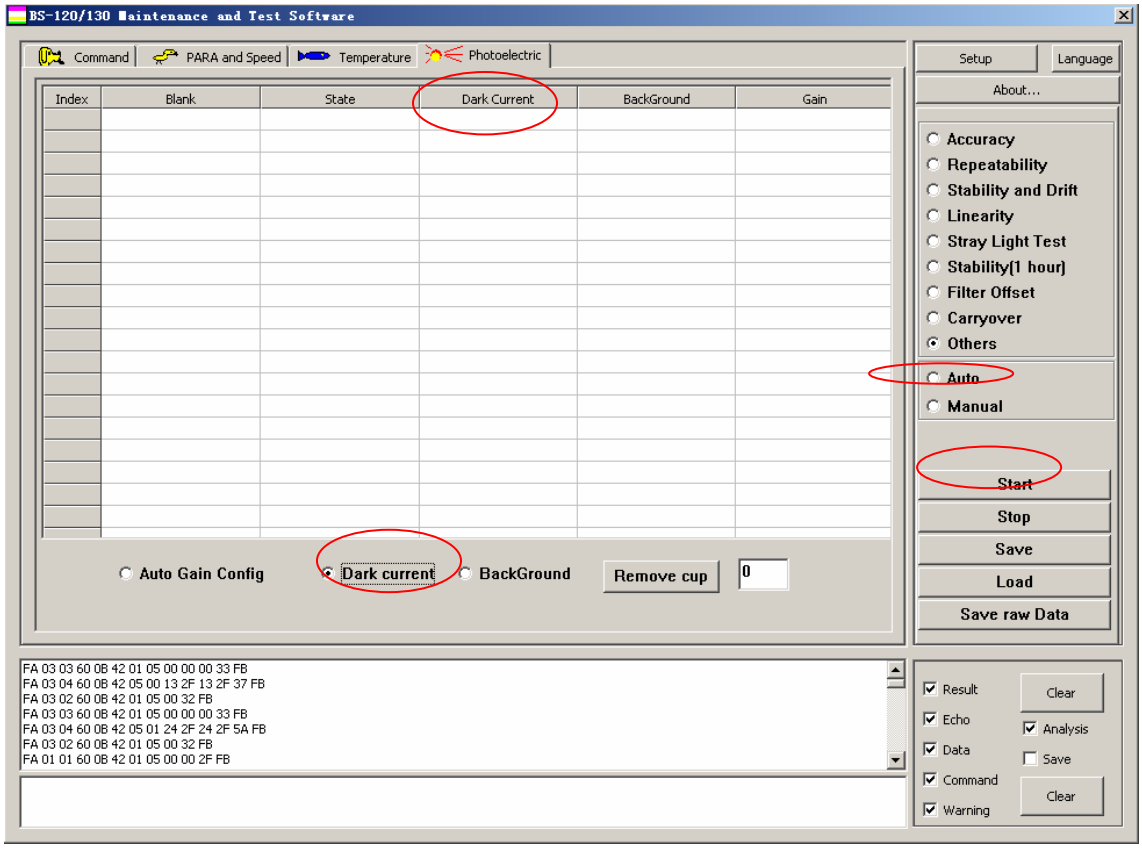
Figure 8-18 Background Test



8.5.4 Dark Current Test

To test the dark current, select ***Photoelectric-Others-Dark current***, and then click ***Start***. After the testing you can view the value of dark current in the ***Dark Current*** column. The order is 340nm, 405nm, 450nm, 510nm, 546nm, 578nm, 630nm and 670nm

Figure 8-19 Dark Current Test Interface



8.5.5 Other Functions of the Photoelectric Test

In the ***Photoelectric*** tab, you can also test the basic performance, including absorbance repeatability, precision, stability, drift, stray light and carryover. Since they are not included in the maintenance procedure, we will not introduce them in this manual.

8.6 Macro Instructions

8.6.1 Function

Each unit tab of the test and maintenance software only includes the basic commands and procedures for ordinary alignment, which do not support more complex and comprehensive tests. However, the ***Macro Instruction*** tab allows you to create necessary instructions or instruction set (macroinstruction) for the tests.

8.6.2 Detailed Operations

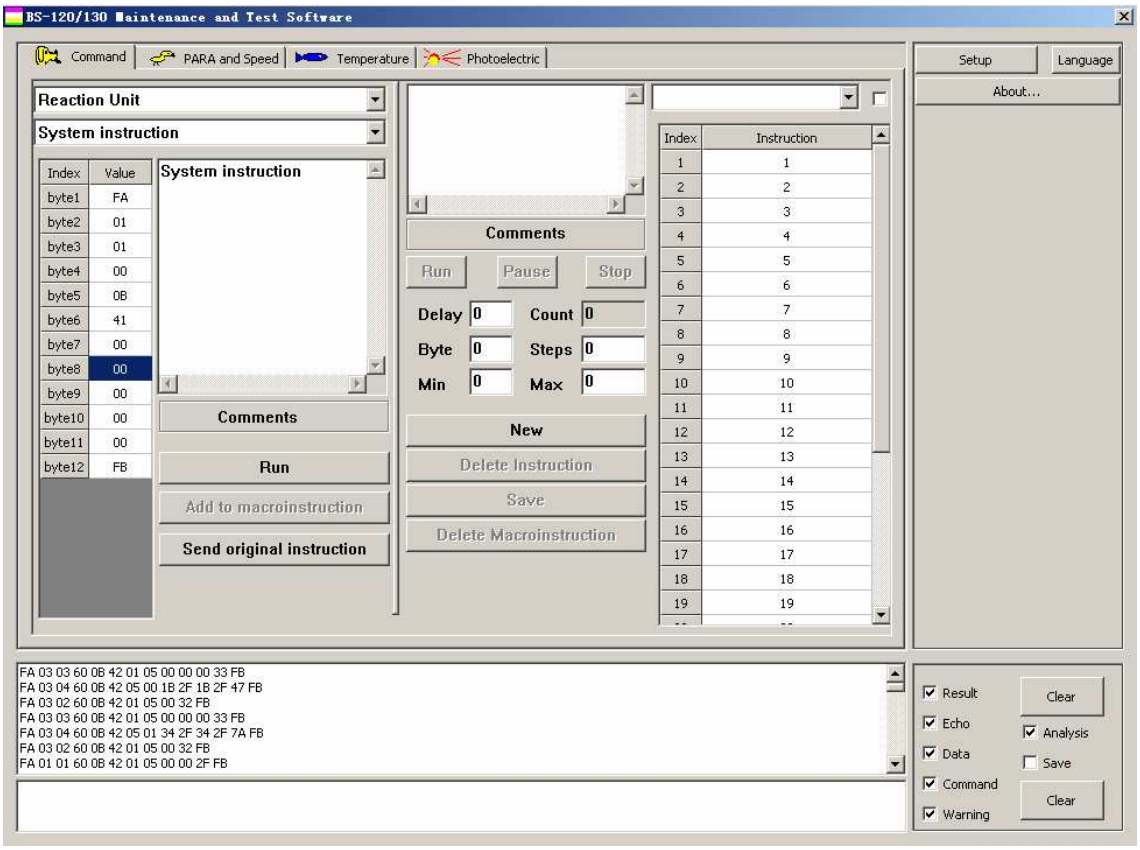
8.6.2.1 Screen Layout

Click the ***Setup*** button on the higher-right area shown in Figure 8-13, input “bs120” to the dialog box and then click ***OK***. You will enter the administrator interface shown in Figure 8-20.

On the right side of the screen is the ***Macro Instruction*** area, in which you can create and edit macro instructions and execute them circularly.

On the left side of the screen is the instruction area, in which you can view the detailed instructions of the specified unit.

Figure 8-20 Macro Instruction Screen



8.6.2.2 Setting up Macro Instruction Name

1) Enter the administrator interface and click ***Setup***, input serial port password “bs120” and then click ***OK***;

2) Select ***New***.

3) Enter the name of the new macro instruction in the popup dialog box, and then select ***OK***. The name appears in the drop-down list box above ***Index*** and ***Instruction***.

8.6.2.3 Adding Single instruction

1) Select or create a macro instruction name.

2) Select an instruction.

   Method: Select the desired unit and the instruction type in the Instruction area. All qualified instructions of the unit are displayed in the lower table.

3) Enter the instruction values.

   - Enter instruction value in the ***Value*** column according to the other information in the table.
   - The last two lines of the ***Value*** column can be left blank.
   - The Value column for the reserved instructions can be left blank.

4) Verify the instructions.

After setting up an instruction, click ***Send*** to verify the exactness in the current environment. If the instruction is correct, the proper response and results frames will be displayed and the available data will be uploaded; If the instruction is not correct, the error message explained in red will be showed up in the information box at the bottom of the screen.

5) Add an instruction to the macro instruction set.

Select ***Add to Macro***. The selected instruction is added to the macro instruction list on the right-hand side of the screen. Repeat steps 1) through 5) to add more instructions.

6) Select ***Save*** below the macro instruction list to save the macro instruction. The newly-created macro instruction is temporarily stored in the memory. If not saved, the macro instruction will disappear when you switch to other instructions or exit the system.

8.6.2.4 Delete Macro Instruction

You can delete the created macro instruction.

To delete created macro instruction, you can choose the macro instructin in the name list, and click ***Delete Instruction***, and then confirm the deletion in the pop-up dialog box.

If you want to delete an instruction, select the instruction in the name list under the name of the macro instruction set, and then click ***Delete Instruction***.

8.6.2.5 Save Macro Instruction

Select **Save** to save a macro instruction to the database so as to be able to execute the instruction after re-open the software. A new created instruction can not be saved after exiting the software if not clicking ***save*****.**

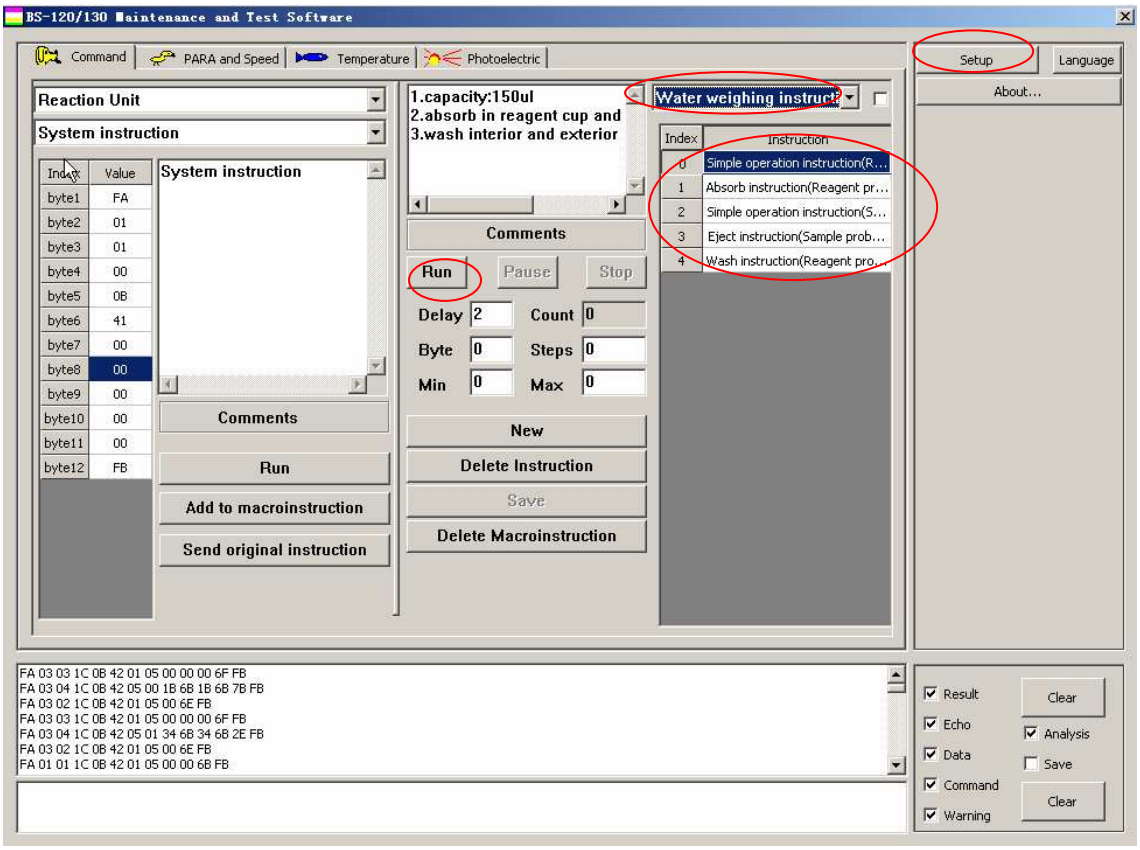
8.6.2.6 Run a Macro Instruction

Click ***Run*** to run the macro instruction. A macro instruction set can be built up with single instruction or multiple instructions. If the macro instruction is built up with multiple instructions, the macro instruction set will be executed by following the order of each single instruction. When all the instructions are executed, the macro instruction finishes one circle.

To run a macro instruction set once, select the checkbox next to the instruction name; the instructions will be executed only once;

To run a macro instruction set circularly, deselect the checkbox; the instructions will be executed circularly until clicking ***stop*** or ***pause.***

Figure 8-21 Run Macro Instruction



9 Troubleshooting

This chapter presents all error messages and recommended corrective actions, which should be taken in time once any error occurs.

The error or warning messages will be displayed in the warning messages area at the bottom of the operating software screen and the warning messages will be recorded in the system log.

The log will record the time, level, code and detailed message of each warning to help user record and search errors.

9.1 Error Message Classification

On the system, the error messages are divided into different types according to their severity.

In case of an error/warning message, check its error code on the ***Logs*** screen and recommended corrective measures in the relevant table.

WARNING

When troubleshooting the analyzer, first find out whether it is necessary to switch off the Main Power or Power.

BIOHAZARD

In case your skin contacts the sample, control or calibrator, follow laboratory safety procedure and consult a doctor.

9.2 Classification of Error Messages

Severity: Warning

Level	Description	Actions taken by the system
0	Errors to neglect	The system only reminds you of the errors and will not take any actions.
1	Errors to flag tests	The system flags the tests when abnormity of the system occurs or the unreliable results are generated due to any reasons during the test
2	Errors to invalidate sample	When a test is invalidated due to the abnormal sample, the system will rerun the test immediately.
3	Errors to skip sample	Samples for certain tests are used out. The system ignores all tests related to the sample and continues with other tests. You can refill the sample and resume the tests after other tests are finished, or after clicking the ***Probe Stop*** button.
4	Errors to invalidate reagent	When a test is invalidated due to the erroneous reagent, the system will rerun the test immediately.
5	Errors to skip reagent	Reagents for certain tests are used out. The system skips all tests related to the reagent and continues with other tests. You can refill the reagent and resume the tests after other tests are finished, or after clicking the ***Probe Stop*** button.
6	Errors to invalidate sample/reagent	The system will invalidate all tests that are related to the reagent and sample.

Severity: Pausing

Level	Description	Actions taken by the system
7	Errors to pause	The system will pause the probe/mixing bar and invalidate all tests but those which already

	mixing bar	have R1, sample and R1 dispensed and stirred.
8	Errors to pause probe	The system will pause the probe and invalidate all tests but those which already have R1, sample and R1 dispensed.

Severity: Stopping analysis

Level	Description	Actions taken by the system
9	Errors to stop analysis in emergency	During analysis, certain errors occur so that photometric measurement of reaction liquid is affected and the reaction disk cannot rotate normally or finish the photometric measurement.

Severity: Forbidding

Level	Description	Actions taken by the system
10	Errors to forbid test	When errors of this level occur, all tests are forbidden even the system is in idle status. If the system is running tests, no tests will continue in the next period, and all unfinished tests will be invalidated. However, you can perform other operations, such as printing test results, inquiring measurement records, etc.

Severity: Startup forbidden

Level	Description	Actions taken by the system
11	Errors to forbid startup	The operating software refuses to start up or is terminated, and then exits and returns to the Windows operating system.

Severity: Invalidating module (Reserved)

Level	Description	Actions taken by the system
12	Errors to invalidate ISE tests	The ISE tests that are affected by bubbled sample or go out of measurement range due to abnormal(insufficiently-aspirated) sample are invalidated and then run again. If the error occurs continuously for 3 times due to the same cause, the system will skip all ISE tests related to the sample during the current batch of tests.

Severity: Forbidding module (Reserved)

Level	Description	Actions taken by the system
13	Errors to forbid sample bar code scanning	When the sample bar code reader goes wrong and cannot scan sample bar code label normally, the system will not try again during the measurement. The sample positions should be set up manually. Only when reconnected and proved to be normal, the sample bar code reader can start working.
14	Errors to forbid ISE	When errors (like calibration slope out of range) occur due to failed ISE component, ISE tests will be forbidden. If such errors occur during measurement, the system will invalidate the failed ISE tests and skip all other ISE tests in current batch. If such errors occur in idle status, the system will not include ISE tests once starting analysis.

Severity: Errors to forbid LIS (Reserved)

Level	Description	Actions taken by the system
15	Errors to forbid LIS	When the LIS host goes wrong or the network connection and settings are improper, the system cannot download sample information from or send test results to LIS. You can use all functions associated to LIS only after reconnecting the system to LIS successfully.

NOTE

Errors of all levels but 11 will be recorded in the error logs once triggered. When level-11 error occurs, the operating software will not take any actions but warn you about the error and wait for your confirmation and then exit.

9.3 Operation Unit Error

Error Code	Error Message	Reason	Corrective Measure
400000010009	System environment error: Operating system error	Operating system is not Windows XP/2000	Reinstall Windows XP or Windows 2000 and the operating software.
400000020009	System environment error: System language library does not exist	System language libraray does not exist or is not installed	Install language liabrary file.
400000030009	System environment error: Text resource library does not exist	Text resource does not exist	Copy the text resource to the right directory.
400000040009	System environment error: Resolution error	Screen resolution is not 1024*768	Set resolution to 1024*768.
400000050000	System environment error: Wrong color	Color is below 16 bits	Set color to 256 and reboot.
400000060000	System environment error: Screen saver shutdown error	Screen saver shutdown error	Shutdown screen saver manually.
400000070000	System environment error: Sleeping shutdown error	Sleeping shutdown error	Shutdown sleeping manually.
400000080009	Operating software error: Memory error	Memory is less than 128M	Install a memory above 128M and reboot.

400000160000	System environment error: Mouse error	Mouse connection error	If this happens again, exit the software, reconnect the mouse and restart the operation unit.
400000190009	Operating software error: Database initialization error	Database file is damaged or lost. Database needs to be re-established. Database is opened exclusively	Recreate an empty database, input or import common parameters
400000200009	Operating software error: Database version error	Database version too high or too low	Use database of the right version.
400000250000	Operating software error: Database searching error	Query records are damaged. Database is locked	Restart the operating system and software.
400000260008	Operating software error: Database updating error(%d)	Record conflict. Required field is empty. Wrong data type. Database is locked	Restart the operating system and software.
400000280000	Operating software error: Database backing up error	Records are in use. Database is locked	Restart the operating system and software.
400000310008	Operating software error: Serial port startup error	Serial port connection eorr or serial port damaged	Check the serial port connection between analyzing unit and operation unit. If it is wrong, reconnect the serial port, after shutting down the Main Power and operation unit power.If the error remains, run serial port initialization.If the error still remains, replace the serial port cable.
400000410000	Operating software error: Help file does not exist	No help document. Help document is damaged. No memory space	Check whether help document exists or is damaged.
400000420000	Operating software error: Help file opening error	No help document. Help document is damaged. No memory space	Check whether help document exists or is damaged.
400000430000	Operating software error: Log read error	Database damaged	After exporting important data, use the new database to import the previously exported data.
400000440000	Operating software error: Log write error	Database damaged	After exporting important data, use the new database to import the previously exported data.

400000460008	Operating software error: Cannot connect to the analyzing unit	Serial port cable not connected; Power shutdown; PC serial port damaged or mainboard of the analyzing unit damaged.	Check the connection of the serial port cable, whether the Power is on, the PC serial port or the serial port cable is damaged.After all the above are excluded, check whether the mainboard serial port is damaged. Restart the analyzing unit and the operating software.
400000470008	Operating software error: Handshake failed	Serial port cable not connected; Power shut down; PC serial port damaged or analyzing unit mainboard of the analyzing unit damaged.	Check the connection of the serial port cable, whether the Power is on, the PC serial prot or the serial port cable is damaged.After all the above are excluded, check whether the mainboard serial port is damaged. Restart the analyzing unit and the operating software.。
400000510009	System environment error: Self-check error	Main unit and subunits selr-check error.	Restart the analyzing unit and operation unit.
400000520008	Operating software error: Parameter downloading error	Parameter downloading failed. Parameter configuration error	Check the connection between the serial port cable and the mainboard. If the mainboard has been replaced, make sure the control software is burnt in. Restart the parameter downloading.
400000530008	Operating software error: Mechanical resetting error	Mechanical resetting error	Check the status of the moving parts and the connection of the fluid path.Run mechanical resetting again. If the error remains, test each moving part to figure out which one goes wrong.
400000540008	Operating software error: Cuvette segment replacing error	Reaction disk movement error.	Use the ***Alignment*** of the operating software to ensure the movement of the reaction disk. After executing falure recovery, replace the cuvette segment.
400000550008	Operating software error: Background measurement error	Photoelectric collection error or light source intensity not enough	Rerun measuring the background. Check the status of the lamp and the filter wheel.
400000560008	Operating software error: Cuvette blank measurement error	Cuvette blank measurement error.	Check whether the cuvettes are alright and the status of the lamp and filter wheel.
400000570008	Operating software error: Washing error	Wash solution not enough, or fluid path connection error.	Check whether there is insuffient DI water, and the connection of fluid path and pump-valve assembly is alright.
400000580008	Operating software error: Startup check is not finished normally	Startup error.	Check the serial port connection. Restart the analyzing unit and operating software, then run startup.

400000590000	Operating software error: Lamp intensity on the low side	Light intensity is weak	Install new lamp or adjust photoelectric gain.
400000600008	Operating software error: Lamp intensity too low. Can't test	Light intensity is weak	Check whether the lamp is installed properly and the status of the filter wheel is alright.If yes, it might be that the lamp reaches its service life and replace it.
400000610008	Operating software error: Dark current checking failed	Dark current too strong	Check the status of the lamp to avoid the system being affected by instense light.
400000620008	Operating software error: Dark current too large	Dark current too strong	Check the status of the lamp to avoid the system being affected by instense light.
400000630008	Operating software error: Both AD values are too similar	Turning on/off light error	Rerun the test after checking the status of the lamp and filter wheel.
400000650008	Operating software error: Lamp turning on failed	Turning on/off light error	Adjust the lamp by using ***Alignment***. If the error remains, check the connection of the lamp.
400000660008	Operating software error: Lamp turning off failed	Turning on/off light error	Adjust the lamp by using ***Aligment***. If the error remains, check the connection of the lamp.
400000690008	Operating software error: Reaction temperature too high	Reaction temperature too high or temperature control error	Shut down Power. Check whether the reaction disk temperature sensor cable and temperature sensor are ok. Check whether the heater and overheat-protection switch are ok.
400000700008	Operating software error: Reaction temperature too low	Reaction disk temperature control error	Check the status of the reaction disk temperature sensor and whether the heater is on.The reaction disk temperature wil return to normal, when the sensor is ok and the heater is turned on for a certain period.
400000710000	Operating software error: Temperature fluctuation	Temperature fluctuation	Check the reaction disk cuvette replacement cover to make sure it is closed.
400000720000	Operating software error: Sending buffer overflows	Sending buffer overflows	Please contact the R&D engineer.

400000730000	Operating software error: Receiving buffer overflows	Receiving buffer overflows	Please contact the R&D engineer.
400000810001	Test result error: No balance point found in …	Reagent, sample error or test parameter configuration error.	Rerun the test after replacing the reagent or sample. If the test parameters are wrong, please reconfigure them.Check whether the optical module is wrong.
400000820001	Test result error: No linear range found in …	Reagent not stable or something wrong with the sample	Rerun the test after replacing the reagent or sample.If the test parameters are wrong, please reconfigure them.Check whether the optical module is wrong.
400000830001	Test result error: Linearity of reaction curve of … too weak	Reagent not stable or something wrong with the sample	Rerun the test, or rerun after the reagent or sample is replaced.If the test parameters are wrong, please reconfigure them. Check whether the optical module is wrong.
400000840001	Test result error: Response of … calculation error	Data of critical points lost.	Rerun the test. Check whether the optical module is wrong.
400000850001	Test result error: Response of … exceeds the one of weakest calibrator	Sample abnormal (hemolysis); calibrator concentration too high	Make sure the calibrator and calibration rule configuration are ok. If not, change the configuration and rerun the calibration and QC. If the sample is abnormal, rerun after the sample is processed. Check whether the optical module is wrong.
400000860001	Test result error: Response of … exceeds the one of strongest calibrator	Sample abnormal (hemolysis); calibrator concentration too low	Make sure the calibrator and calibration rule configuration are ok. If not, change the configuration and rerun the calibration and QC. If the sample is abnormal, rerun after the sample is processed. Check whether the optical module is wrong.
400000870001	Test result error: Concentration of … exceeds the low limit of linear range	Reagent not stable or something wrong with the sample	Rerun the test, or rerun after the reagent or sample is replaced.If the test parameters are wrong, please reconfigure them. Check whether the optical module is wrong.
400000880001	Test result error: Concentration of … exceeds the high limit of linear range	Reagent not stable or something wrong with the sample	Rerun the test, or rerun after the reagent or sample is replaced. If the test parameters are wrong, please reconfigure them. Check whether the optical module is wrong.

400000910001	Test result error: Absorbance of … too low	Reagent not stable or something wrong with the sample	Rerun the test, or rerun after the reagent or sample is replaced. Check whether the optical module is wrong.
400000920001	Test result error: Absorbance of … too high	Reagent not stable or something wrong with the sample	Rerun the test, or rerun after the reagent or sample is replaced. Check whether the optical module is wrong.
400000930001	Test result error: Reagent blank of … too low	Reagent left open for too long, or expired.	Rerun the test after replacing the reagent.
400000940001	Test result error: Reagent blank of … too high	Reagent left open for too long, or expired.	Rerun the test after replacing the reagent.
400000950001	Test result error: R2 blank of … too low	Reagent left open for too long, or expired.	Rerun the test after replacing the reagent.
400000960001	Test result error: R2 blank of … too high	Reagent left open for too long, or expired.	Rerun the test after replacing the reagent.
400000970001	Test result error: Sample blank of … too low	Something wrong with the sample	After confirming the sample is normal, rerun the test. Check whether the optical module is wrong.
400000980001	Test result error: Sample blank of … too high	Something wrong with the sample	Rerun sample dilution. Check whether the optical module is wrong.
400000990001	Test result error: Substrate of … exhausted	Substrate exhausted	Check whether the test parameter configuration is ok. If not, rerun the calibration after changing the parameters.Or rerun the test after dilutionIt is possible that carryover might exsit. Set the carryover in the operating software.
400001000001	Test result error: Abnormal prozone check of …	Antigen excess. Sample too much or sample concentration too high	Check if the test parameter configuration is ok.If wrong, rerun the calibration after changing the parameters.Or rerun the test after dilutionIt is possible that carryover might exsit. Set the carryover in the operating software.
400001010001	Test result error: Calibration parameter of … calculation failed	Calibration parameter calculation error	Replace the reagent and calibrators. Confirm the calibrators and calibration rule. Recalibrate.If the error remains, check the optical system.

400001020001	Test result error: Calibration SD of … too large	Calibration SD too high	Replace the reagent and calibrators. Confirm the calibrators and calibration rule. Recalibrate. If the error remains, check the optical system.
400001030001	Test result error: Difference between calibration coefficients of … too large	Something wrong with the calibrator and reagent	Replace the reagent and calibrators. Confirm the calibrators and calibration rule. Recalibrate. If the error remains, check the optical system.
400001040001	Test result error: Calibration related coefficients of … too low	Something wrong with the calibrator and reagent	Replace the reagent and calibrators. Confirm the calibrators and calibration rule. Recalibrate. If the error remains, check the optical system.
400001050001	Test result error: Incomplete repeated calibration data of …	Something wrong with the calibrator and reagent	Replace the reagent and calibrators. Confirm the calibrators and calibration rule. Recalibrate. If the error remains, check the optical system.
400001060001	Test result error: Calibration curve of … not monotonic	Something wrong with the calibrator and reagent	Replace the reagent and calibrators. Confirm the calibrators and calibration rule. Recalibrate. If the error remains, check the optical system.
400001070001	Test result error: Concentration of … calculation failed	Something wrong with the calibrator and reagent	Replace the reagent and calibrators. Confirm the calibrators and calibration rule. Recalibrate. If the error remains, check the optical system.
400001080001	Test result error: Incomplete test result of …	Rerun calibration not completed. or insufficient reagent and calibrator.	Refill the reagent and calibrator; recalibrate.
400001090001	Test result error: Error of repeated … too large	Something wrong with the calibrator and reagent	Replace the reagent and calibrators. Confirm the calibrators and calibration rule. Recalibrate. If the error remains, check the optical system.
400001100000	Test result error: QC out of control	Control performance degraded; something wrong with the reagent	Replace the reagent and calibrators. Confirm the calibrators and calibration rule.Rerun.If the error remains, check the optical system.
400001140006	Operating software error: Detergent exhausted, or invalid sensor	Wash solution used up or sensor invalidated	Check the DI tank. If there is insufficient DI water, refill it and execute failure recovery.
400001150006	Operating software error: Waste full	Waste tank full	Check the waste tank. If it is full, empty it and execute failure recovery.
400001350000	Test result error: Blank response of … too low	Blank reponse too low	Check the cuvette, reagent and diluent.

400001360000	Test result error: Blank response of … too high	Blank reponse too high	Check the cuvette, reagent and diluent.
400001370000	Test result error: Calibration sensitivity of … too low	Reagent blank ABS too high or decreased ABS resulting from calibrator degradation	Refill the reagent and replace calibrator; recalibrate.
500000170000	System environment error: Printer connection error	Printer connection error	Check the connection between the printer and the operation unit and make sure the printer is turned on.
500001160000	Operating software error: … is out of date. Please replace in time	Expired	Replace the software.
500001180000	Operating software error: Calibration interval of … is out. Please re-calibrate in time	Calibration interval reached	Recalibrate.

9.4 Analyzing Unit Error

9.4.1 Main Unit

Error Code	Error Message	Reason	Corrective Measure
100640010007	Main unit result error: Command error	Main unit receiving command frame error	Shut down Power and restart the PC and open the operating software. Execute failure recovery. Please contact the R&D engineer if the error repeats for 3 times.
100640020007	Main unit result error: Self-check error	Self-check error	Shut down Power and restart the PC and open the operating software. Execute failure recovery. Please contact the R&D engineer if the error repeats for 3 times.
100640030007	Main unit result error: Shaking hands with other units	Shaking hands with other units	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting and check whether the mainboard connection is ok.

100640040007	Main unit result error: Shaking hands with other units error	Something wrong with the connection cable or controlling unit is executing other operations	Check whether the mainboard connection is OK. Restart the analyzing unit and reopen the operating software. If it repeats for several times, please contact the R&D engineer.
100640050007	Main unit result error: E2PROM read error	E2PROM read error	Restart the analyzing unit and the operating software. Execute failure recovery. If the error remains, replace the mainboard.
100640080007	Main unit result error: E2PROM write error	E2PROM write error	Restart the analyzing unit and the operating software. Execute failure recovery. If the error remains, replace the mainboard.
100640090007	Main unit result error: Downloading parameter	Main unit downloading parameters to subunits; unable to response	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting or check the connection of the mainboard.
100640100007	Main unit result error: Parameter downloading failed	Mainboard connection error or wrong parameter downloading or wrong parameter configuration	Check the connection of the mainboard.Reopen the operating software after restarting the analyzing unit.If the error remains, replace the mainboard.
100640110007	Main unit result error: Resetting other units	Resetting other units; unable to response.	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting or check the connection of the mainboard.
100640120007	Main unit result error: Other units resetting error	Other units resetting error	Execute failure recovery. If ithe error repeats continuously for more than 3 times, please contact the R&D engineer.
100640150007	Main unit result error: Invalid status. Self-check	Self-checking; Other operations not supported	Run the previous operation after waiting for 30-60 seconds.If there is no response for a long time, execute mechanical resetting or restart analyzing unit. If ithe error repeats for several times, please contact the R&D engineer.
100640150017	Main unit result error: Invalid status. Error	Main unit error; other operations not supported	Execute failure recovery; if the error repeats, replace the mainboard.
100640160007	Main unit result error: Unit busy. No response	Busy. No response	Run the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting or restart analyzing unit and the operating software.

100640170007	Main unit result error: Analyzing error. Reaction disk affected	Other units status error. Photoelectric collection affected	Restart the analyzing unit and open the operating software. Execute failure recovery. If the error repeats continuously for 3 times, please contact the R&D engineer.
100640180006	Main unit result error: Analyzing error. Reaction disk not affected	Other units status error. Photoelectric collection not affected	After the tests are finished, restart the analyzing unit and open the operating software. Execute failure recovery.If the message appears continuously for 3 times, please contact the R&D engineer.
100640300007	Main unit result error: Parameter write protection	Parameter write protection	Parameter write protection is permitted.
100640310007	Main unit result error: No result, or timeout	System connection error or other units error	Check the connection of the system; restart the analyzing unit and open the operating software. Execute failure recovery.

9.4.2 Sample/Reagent Unit

Error Code	Error Message	Reason	Corrective Measure
100680010005	Sample unit result error: Command error	Commamd sending error or wrong command information	Restart the analyzing unit and rerun the operating software. If the error repeats continuously for 3 times, please contact the R&D engineer.
100680020005	Sample unit result error: Self-check error	Self-check error	Restart the analyzing unit and rerun the operating software. If the error repeats continuously for 3 times, please contact the R&D engineer.
100680030005	Sample unit result error: Mechanical resetting error	Mechanical resetting error	Reset the mechanical parts by using ***Aligment***. If the error remains, check the connection of the motor and the sensor.
100680040005	Sample unit result error: Status error. Self-check	Self-checking; other operations not supported	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting. If the error remains, restart the analyzing unit and the operating software.

100680040015	Sample unit result error: Status error. Error	sample unit error; current operations not supported	Execute failure recovery. If not successful, check the sample probe, sample/reagent disk diriver motor/sensor and the connection and then execute failure recovery.
100680050005	Sample unit result error: Unit busy. No response	Unit busy. No response	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, restart the analyzing unit and reopen the operating software.
100680090005	Sample unit result error: Wrong configuration parameter	Parameter configuration error	Configure the right parameter.
100680170005	Sample unit result error: Fluid controlling error	Fluid path control error	Check the connection of DI water and waste sensor. Check whether the syringe is leaking, or there is hanging liquid on the sample probe, the pump-valve assembly is wrong. Restart the analyzing unit and open the operating software. Adjust the fluid path function by using ***Alignment***.
100680180005	Sample unit result error: Sample disk rotation error. Cannot reach the home position	Sample disk rotation error	Check the connection of sample/reagent disk motor/sensor. Execute failure recovery.
100680180015	Sample unit result error: Sample disk rotation error. Cannot move away from the home position	Sample disk rotation error	Check the connection of sample/reagent disk motor/sensor. Execute failure recovery.
100680180025	Sample unit result error: Sample disk rotation error. Step missing	Sample disk rotation error	Check the sample/reagent disk diriver motor/sensor and the connection. Check whether the rotation of the sample/reagent disk is blocked. Execute failure recovery.
100680180035	Sample unit result error: Sample disk rotation error. Probe in disk	Sample disk rotation error. Probe in the disk	Execute sample disk rotation after moving the sampole probe out of the sample disk by using ***Alignment***.

100680180045	Sample unit result error: Sample disk rotation error. Disabled	Sample disk rotation error. Forbidden	Rotate the sample disk after executing mechanical resetting.
100680200005	Sample unit result error: Syringe error. Full aspiration failed	Syringe error, can not fully aspirate.	Check the status of the syringe. Reset the syringe by using ***Alignment***.
100680200015	Sample unit result error: Syringe error. Full dispensing failed	Syringe error, can not fully dispense.	Check the status of the syringe. Reset the syringe by using ***Alignment***.
100680200025	Sample unit result error: Syringe error. Cannot reach the home position	Syringe error. Cannot reach the home position	Cehck the connection and status of the syringe. Reset the syringe by using ***Alignment***.
100680200035	Sample unit result error: Syringe error. Cannot move away from the home position	Syringe error. Cannot leave the home position	Check the connection and status of the syringe. Reset the syringe by using ***Alignment***.
100680200045	Sample unit result error: Syringe error. Inadequate aspiration	Syringe error. Aspiration not enough	Check the status of the syringe. Reset the syringe by using ***Alignment***.
100680200055	Sample unit result error: Syringe error. Inadequate dispensing	Syringe error. Dispension not enough	Check the status of the syringe. Reset the syringe by using ***Alignment***.
100680200065	Sample unit result error: Syringe error. Step missing	Syringe error. Step missing	Check the connection and status of the syringe. Reset the syringe by using ***Alignment***.
100680200075	Sample unit result error: Syringe error. Aspirating/dispensing not allowed now	Syringe error. Dispension and aspiration forbidden	Check the connection and status of the syringe. Rotate the sample disk after executing the operation.

100680210005	Sample unit result error: Sample probe horizontal movement error. Cannot reach the home position	Sample probe horizontal movement error. Cannot reach the home position	Check the connection between probe horizontal movement motor and the sensor. Check whether the sample probe horizontal movement is blocked. Execute mechanical resetting.
100680210015	Sample unit result error: Sample probe horizontal movement error. Cannot move away from the home position	Sample probe horizontal movement error. Cannot leave the home position	Check the connection between probe horizontal movement motor and the sensor. Check whether the sample probe horizontal movement is blocked. Execute mechanical resetting.
100680210055	Sample unit result error: Sample probe horizontal movement error. Step missing	Sample probe horizontal movement error. Step missing.	Check the movement of the sample probe by using ***Alignment***. Check whether the horizontal movement of the sample probe is blocked. Execute mechanical resetting.
100680210065	Sample unit result error: Sample probe horizontal movement error. Disabled	Sample probe horizontal movement error. Forbidden.	Execute mechanical resetting.
100680220005	Sample unit result error: Sample probe vertical movement error. Cannot reach the home position	Sample probe vertical movement error. Cannot reach the home position	Check the connection between probe vertical movement motor and the sensor. Check whether the sample probe vertical movement is blocked. Execute mechanical resetting.
100680220015	Sample unit result error: Sample probe vertical movement error. Cannot move away from the home position	Sample probe vertical movement error. Cannot leave the home position	Check the connection between probe vertical movement motor and the sensor. Check whether the sample probe vertical movement is blocked. Execute mechanical resetting.
100680220025	Sample unit result error: Sample probe vertical movement error. Trying to move away from the initial limit position	Sample probe vertical movement error. Trying to move away from the initial limit position	Execute mechanical resetting. If the error remains, check the status of the sensor.

100680220035	Sample unit result error: Sample probe vertical movement error. Trying to move away from the sample disk limit position	Sample probe vertical movement error. Trying to move away from the sample disk limit position	Execute mechanical resetting. If the error remains, check the status of the sensor.
100680220045	Sample unit result error: Sample probe vertical movement error. Trying to move away from the washing limit position	Sample probe vertical movement error. Trying to move away from the washing limit position	Execute mechanical resetting. If the error remains, check the status of the sensor.
100680220055	Sample unit result error: Sample probe vertical movement error. Trying to move away from the reaction disk limit position	Sample probe vertical movement error. Trying to move away from the reactiondisk limit position	Execute mechanical resetting. If the error remains, check the status of the sensor.
100680220065	Sample unit result error: Sample probe vertical movement error. No liquid surface detected	Insufficient sample or reagent volume	After pausing the sample prbobe, check whether the sample/reagent is on the right position. If yes, check whether the level detection board is wrong.
100680220075	Sample unit result error: Sample probe vertical movement error. Collision	Sample probe vertical movement error. Collision	After pausing the sample probe, check whether the vertical movement of the sample probe is blocked. If not, check the status of the sample probe vertical collision protection sensor and the blocking plate. Execute mechanical resetting.
100680220085	Sample unit result error: Sample probe vertical movement error. Step missing	Sample probe vertical movement error. Step missing	Check the vertical movement motor and the sensor. Check whether the vertical movement is blocked. Execute mechanical resetting.

100680220095	Sample unit result error: Sample probe vertical movement error. Sample disk or reaction disk is rotating	Vertical movement not permitted	Check the status of the probe and the disk. Execute mechanical resetting.
100680220105	Sample unit result error: Sample probe vertical movement error. Disabled	Vertical movement not permitted	Check the status of the probe and the disk. Execute mechanical resetting.
100680260005	Sample unit result error: Parameter write protection of this unit	Unit parameter write protection. Parameter configuration forbidden	Configure parameter after parameter configuration is permitted.
100681250005	Sample unit result error: Main unit sending error	/	Shut down Power, restart the operating software, and retry this command. If the error remains, check the cable and the board.
100681270005	Sample unit result error: Main unit does not receive the sample unit result	/	Shut down Power, restart the operating software, and retry this command. If the error remains, check the cable and the board.

9.4.3 Reaction Disk Unit

Error Code	Error Message	Reason	Corrective Measure
100650010005	Reaction unit result error: Command error	Commamd sending error or wrong command information	Reset Power and restart the operating software. Retry this command. If the error remains, please contact the R&D engineer.
100650020005	Reaction unit result error: Self-check error	Self-check error	Reset Power and restart the operating software. Retry this command. If the error remains, please contact the R&D engineer.

100650030005	Reaction unit result error: Mechanical resetting error	Mechanical resetting error	Check the motor/sensor/cable. Run mechanical resetting. If the error remains, restart the analyzing unit and the operating software. Rerun mechanical resetting again.
100650040005	Reaction unit result error: Invalid status. Self-check	Self-checking; Other operations not supported	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting or restart the analyzing unit and the operating software.
100650040015	Reaction unit result error: Invalid status. Error	Reaction unit error; current operations not supported	Execute failure recovery. Check the motor/sensor/cable. If the error remains, please contact the R&D engineer.
100650040025	Reaction unit result error: Invalid status. Waiting for handshake	Unit busy. No response	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting or restart the analyzing unit. Rerun the operating software.
100650050005	Reaction unit result error: Unit busy. No response	Unit busy. No response	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting or restart the analyzing unit and the operating software.
100650090005	Reaction unit result error: Wrong configuration parameter	Parameter configuration error	Configure the right parameter.
100650110005	Reaction unit result error: Undefined search	Undefined search	Input the right searching parameter.
100650130005	Reaction unit result error: Wrong system operation parameter	Wrong system operation parameter	Input the right operation parameter.
100650140005	Reaction unit result error: Configure undefined parameter	Reaction unit error. Can not find home position	Check the motor/sensor/cable. Check the movement of the reaction disk by using ***Aligment***. If the error remains, contact the R&D engineer.

100650140015	Reaction unit result error: Rotation error. Cannot move away from the home position	Reaction unit error. Can not find home position	Check the motor/sensor/cable. Check the movement of the reaction disk by using ***Aligment***. If the error remains, contact the R&D engineer.
100650140025	Reaction unit result error: Rotation error. Step missing	Reaction unit error. Can not find home position	Check the motor/sensor/cable. Check the movement of the reaction disk by using ***Aligment***. If the error remains, contact the R&D engineer.
100650140045	Reaction unit result error: Rotation error. Mixing	Mixing. Rotation not permitted	Rotate the reaction disk after mixing is finished and the mixing bar leaves the cuvettes.
100650140055	Reaction unit result error: Rotation error. Aspirating/dispensing sample	Aspirating/dispensing sample. Rotation not permitted	Rotate the reaction disk after sample aspirating/dispensing is finished.
100650140065	Reaction unit result error: Rotation error. Aspirating/dispensing reagent	Aspirating/dispensing reagent. Rotation not permitted	Rotate the reaction disk after reagent aspirating/dispensing is finished.
100650140075	Reaction unit result error: Rotation error. Aspirating/dispensing R2	Aspirating/dispensing R2. Rotation not permitted	Rotate the reaction disk after R2 aspirating/dispensing is finished.
100650150005	Reaction unit result error: Photoelectric error. Lamp off	Photoelectric error. Lamp off	After adjusting the lamp by using ***Alignment***, run photoelectric collection. If the error remains, please contact the R&D engineer.
100650150015	Reaction unit result error: Photoelectric error. Lamp too dark	Lamp intensity not enough or lamp off	Check the status of the lamp and its connection. Check the installation of the lamp. Replace the lamp if necessary.

100650150025	Reaction unit result error: Photoelectric error. Signal collection busy	Running photoelectric collection. Other operations not supported.	Run other operations, after photoelectric collection is finished.
100650150035	Reaction unit result error: Photoelectric error. Lamp On/Off actions are opposite	Lamp On/Off actions are opposite	Adjust the lamp by using ***Alignment***. If the error remains, contact the R&D engineer.
100650150045	Reaction unit result error: Photoelectric measurement error. Filter home position lost.	Filter wheel step missing or error	Shut down the Power, restart the operating software, and retry this command. If the error remains, contact the R&D engineer.
100650150055	Reaction unit result error: Photoelectric measurement error. Timeout.	Other units connection error	Check the status of the filter wheel and the connection of the optical module. Reset the Power and rerun the command. If the error remains, contact the R&D engineer.
100650190005	Reaction unit result error: Parameter modify protection	Unit parameter write protection. Parameter configuration forbidden	Configure parameter after parameter configuration is permitted.
100651250005	Reaction unit result error: Main unit sending error	/	Shut down Power, restart the operating software, and retry this command. If the error remains, check the cable and the board.
100651270005	Reaction unit result error: Main unit does not receive the reaction unit result	/	Shut down the Power, restart the operating software, and retry this command. If the error remains, check the cable and the board.

9.4.4 Temperature Unit

Error Code	Error Message	Reason	Corrective Measure
100660010000	Temperature unit result error: Command error	Command sending error or wrong command information	Reset the Power, restart the operating software,and retry this command. If the error remains, please contact the R&D engineer.
100660020000	Temperature unit result error: Self-check error	Self-check error	Shut down the Power, restart the operating software, and retry this command. If the error remains, turn off the analyzing unit, check the temperature sensor and the cable.
100660030000	Temperature unit result error: Mechanical resetting error	Mechanical resetting error	Reset the mechanical parts by using ***Alignment***. If the error remains, please contact the R&D engineer.
100660040000	Temperature unit result error: Status error. Self-check	Self-checking; Other operations not supported	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting.
100660040010	Temperature unit result error: Status error. Error	Temperature unit error; current operations not supported	Execute failure recovery. If it repeats continuously for several times, please contact the R&D engineer.
100660040020	Temperature unit result error: Status error. Waiting for handshake	Unit busy. No response	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting. If it repeats for several times, please contact the R&D engineer.
100660050000	Temperature unit result error: Unit busy. No response	Unit busy. No response	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting. If it repeats for several times, please contact the developer.
100660070000	Temperature unit result error: Wrong searching parameter	Wrong system operation parameter	Input the right searching parameter.

100660080000	Temperature unit result error: Undefined temperature parameter	Wrong system operation parameter	Configure the right parameter.
100660090000	Temperature unit result error: Wrong temperature parameter	Wrong system operation parameter	Configure the right parameter.
100660100000	Temperature unit result error: Undefined sensor parameter	Undefined sensor parameter	Configure the right parameter.
100660110000	Temperature unit result error: Wrong sensor parameter	Wrong sensor parameter	Configure the right parameter.
100660120000	Temperature unit result error: Undefined target temperature	Undefined target temperature	Configure the right parameter.
100660130000	Temperature unit result error: Wrong target temperature parameter	Wrong target temperature parameter	Configure the right parameter.
100660160000	Temperature unit result error: Parameter write protection	Unit parameter write protection. Parameter configuration forbidden	Configure the parameter after parameter configuration is permitted.
100661250000	Temperature unit result error: Main unit sending error	/	Check the connection of the temperature unit. Restart the operating software and retry the command. If the error repeats for several times, check the cable and the board.
100661270000	Temperature unit result error: Main unit does not receive the Temperature unit result	/	Check the connection of the temperature unit. Restart the operating software and retry the command. If the error repeats for several times, check the cable and the board.

9.4.5 Mixing Unit

Error Code	Error Message	Reason	Corrective Measure
100670010005	Mixing unit result error: Command error	Command sending error or wrong command information	Reset the Power and restart the operating software, then retry this command. If the message repeats continuously for 3 times, please contact the R&D engineer.
100670020005	Mixing unit result error: Self-check error	Self-check error	Reset the Power and restart the operating software and retry this command. If the message repeats continuously for 3 times, please contact the R&D engineer.
100670030005	Mixing unit result error: Mechanical resetting error	Mechanical resetting error	Reset the mechanical parts by using ***Alignment***. If the warning remains, check the connection of the motor and the sensor.
100670040005	Mixing unit result error: Status error. Self-check	Self-checking; Other operations not supported	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting. If the error repeats for several times, please contact the R&D engineer.
100670040015	Mixing unit result error: Status error. Error	Mixing unit error; current operations not supported	Execute failure recovery. If the warning remains, check the connection of the motor and the sensor.
100670040025	Mixing unit result error: Status error. Waiting for handshake	Unit busy. No response	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting. If it repeats for several times, please contact the R&D engineer.
100670050005	Mixing unit result error: Unit busy. No response	Unit busy. No response	Execute the previous operation after waiting for 30-60 seconds. If there is no response for a long time, execute mechanical resetting. If it repeats for several times, please contact the R&D engineer.
100670080005	Mixing unit result error: Undefined configuration	Undefined configuration	Configure the right parameter.
100670090005	Mixing unit result error: Wrong configuration parameter	Wrong configuration parameter	Configure the right parameter.

100670110005	Mixing unit result error: Wrong searching parameter	Wrong searching parameter	Configure the right searching parameter.
100670170005	Mixing unit result error: Mixing bar vertical movement error. Cannot reach the home position	Mixing motor/sensor/cable or mixing unit error.	Check the movement of the mixing bar by using ***Alignment***. If the warning remains, check the connection of the motor and the sensor.
100670170015	Mixing unit result error: Mixing bar vertical movement error. Cannot move away from the home position	Mixing motor/sensor/cable or mixing unit error.	Check the movement of the mixing bar by using ***Alignment***. If the warning remains, check the connection of the motor and the sensor.
100670170025	Mixing unit result error: Mixing bar vertical movement error. Trying to move away from the home position	Mixing motor/sensor/cable or mixing unit error.	Check the movement of the mixing bar by using ***Alignment***. If the warning remains, check the connection of the motor and the sensor.
100670170035	Mixing unit result error: Mixing bar vertical movement error. Trying to move away from the washing limit position	Mixing motor/sensor/cable or mixing unit error.	Check the movement of the mixing bar by using ***Alignment***. If the warning remains, check the connection of the motor and the sensor.
100670170045	Mixing unit result error: Mixing bar vertical movement error. Trying to move away from the mixing limit position	Mixing motor/sensor/cable or mixing unit error.	Check the movement of the mixing bar by using ***Alignment***. If the warning remains, check the connection of the motor and the sensor.

100670170095	Mixing unit result error: Mixing bar vertical movement error. Reaction disk is rotating	Reaction disk rotating. Mixing not permitted	Run mechanical resetting or mixing unit mechanical resetting. Rotate the reaction disk after mixing bar leaves the cuvettes.
100670200005	Mixing unit result error: Write protection	Unit parameter write protection. Parameter configuration forbidden	Configure parameter after iparameter configuration is permitted.
100671250005	Mixing unit result error: Main unit sending error	/	Check the connection of the mixing unit. Restart the operating software and retry the command. If the error repeats for several times, check the cable and the board.
100671270005	Mixing unit result error: Main unit does not receive the mixing unit result	/	Check the connection of the mixing unit. Restart the operating software and retry the command. If the error repeats for several times, check the cable and the board.

9.4.6 ISE Unit

Error Code	Error Message	Reason	Corrective Measure
10070001BBA5	ISE unit result error: Bubble calibration cycle error. Air in calibrant A	Calibrator A bottle empty; tube not connected; pump A not working; tube blocked, broken or twisted; fibrin and salt in the tube; air bubble detector error; waste pump error	Wrong electrode installation. Check the pressing plate spring and the sealing to ensure all the electrodes and the O-ring are in the right place. Wash the module by using <CLEN > program. Remove the module and then wash it. Reinstall the sensor. Replace air bubble detection sensor; replace the waste pump; replace the calibrator A and recalibrate; reconnect or replace the tube; check the connection of the motor; replace the pump box; replace the motor; replace the tube.
10070001BBD5	ISE unit result error: Bubble calibration cycle error. Bubble detector failure	air bubble detector error	Replace air bubble detection sensor;.
10070001BBF5	ISE unit result error: Bubble calibration cycle error. No flow	No flow; wrong electrode installation	Replace the calibrator A and B, and then recalibrate; check the installation of the electrodes.

10070001CAA5	ISE unit result error: Calibration cycle error. Air in calibrant A	Calibrator A bottle empty; tube not connected; pump A not working; tube blocked, broken or twisted; fibrin and salt in the tube; air bubble detector error; waste pump error	Wrong electrode installation. Check the pressing plate spring and the sealing to ensure all the electrodes and the O-ring are in the right place. Wash the module by using <CLEN > program. Remove the module and then wash it. Reinstall the sensor. Replace air bubble detection sensor; replace the waste pump; replace the calibrator A and recalibrate; reconnect or replace the tube; check the connection of the motor; replace the pump box; replace the motor; replace the tube.
10070001CAB5	ISE unit result error: Calibration cycle error. Air in calibrant B	Calibrator B bottle empty; tube not connected; pump B not working; tube blocked, broken or twisted; fibrin and salt in the tube; air bubble detector error; waste pump error	Wrong electrode installation. Check the pressing plate spring and the sealing to ensure all the electrodes and the O-ring are in the right place. Wash the module by using <CLEN > program. Remove the module and then wash it. Reinstall the sensor. Replace air bubble detection sensor; replace the waste pump; replace the calibrator A and recalibrate; reconnect or replace the tube; check the connection of the motor; replace the pump box; replace the motor; replace the tube.

10070001CAF5	ISE unit result error: Calibration cycle error. No flow	No flow; wrong electrode installation	Replace the calibrator A and B, and then recalibrate; check the installation of the electrodes.
10070001CAM5	ISE unit result error: Calibration cycle error	Electrodes damaged	Check the status of the electrodes and replace the damaged one.
10070001CAQ5	ISE unit result error: Calibration cycle error. Calibration value saving failed	Software read/write error	Execute the command for 3 times. If the error remains, contact the R&D engineer.
10070001CLA5	ISE unit result error: Clean cycle error. Air in calibrant A	Wrong electrode installation. Check the pressing plate spring and the sealing to ensure all the electrodes and the O-ring are in the right place. Calibrator A bottle empty; tube not connected; pump A not working; tube blocked, broken or twisted; fibrin and salt in the tube; air bubble detector error; waste pump error	Wash the module by using <CLEN > program. Remove the module and then wash it. Reinstall the sensor. Replace air bubble detection sensor; replace the waste pump; replace the calibrator A and recalibrate; reconnect or replace the tube; check the connection of the motor; replace the pump box; replace the motor; replace the tube.
10070001CLC5	ISE unit result error: Clean cycle error. Air in cleaner	No ISE wash solution air bubble detector error; waste pump error	Replace air bubble detection sensor; replace waste pump; refill ISE wash solution.
10070001CLF5	ISE unit result error: Clean cycle error. No flow	No ISE wash solution	Refill ISE wash solution

10070001CLM5	IISE unit result error: Clean cycle error	No ISE wash solution	Refill ISE wash solution
10070001COM5	ISE unit result error: Communication error	ISE connection error	Reconnect; reset ISE; turn on the power of ISE module .
10070001GAA5	ISE unit result error: Purge A cycle error. Air in calibrant A	Calibrator A bottle empty; tube not connected; pump A not working; tube blocked, broken or twisted; fibrin and salt in the tube; air bubble detector error; waste pump error	Wrong electrode installation. Check the pressing plate spring and the sealing to ensure all the electrodes and the O-ring are in the right place. Wash the module by using <CLEN > program. Remove the module and then wash it. Reinstall the sensor. Replace air bubble detection sensor; replace the waste pump; replace the calibrator A and recalibrate; reconnect or replace the tube; check the connection of the motor; replace the pump box; replace the motor; replace the tube.
10070001GAF5	ISE unit result error: Purge A cycle error. No flow	Calibrator A bottle empty; wrong electrode installation	Replace the calibrator A, then recalibrate; check the installation of the electrodes.

10070001GBB5	ISE unit result error: Purge B cycle error. Air in calibrant B	Calibrator B bottle empty; tube not connected; pump A not working; tube blocked, broken or twisted; fibrin and salt in the tube; air bubble detector error; waste pump error	Wrong electrode installation. Check the pressing plate spring and the sealing to ensure all the electrodes and the O-ring are in the right place. Wash the module by using <CLEN > program. Remove the module and then wash it. Reinstall the sensor. Replace air bubble detection sensor; replace the waste pump; replace the calibrator B and recalibrate; reconnect or replace the tube; check the connection of the motor; replace the pump box; replace the motor; replace the tube.
10070001GBF5	ISE unit result error: Purge B cycle error. No flow	Calibrator B bottle empty; wrong electrode installation	Replace the calibrator B, then recalibrate; check the installation of the electrodes.

10070001PMA5	ISE unit result error: Clean cycle error. Air in cleaner	Calibrator A bottle empty; tube not connected; pump A not working; tube blocked, broken or twisted; fibrin and salt in the tube; air bubble detector error; waste pump error	Wrong electrode installation. Check the pressing plate spring and the sealing to ensure all the electrodes and the O-ring are in the right place. Wash the module by using <CLEN > program. Remove the module and then wash it. Reinstall the sensor. Replace air bubble detection sensor; replace the waste pump; replace the calibrator A and recalibrate; reconnect or replace the tube; check the connection of the motor; replace the pump box; replace the motor; replace the tube.
10070001PMF5	ISE unit result error: Pump calibration cycle error. No flow	Calibrator A and B bottle empty; wrong electrode installation	Replace the calibrator A and B, then recalibrate; check the installation of the electrodes.
10070001PMP5	ISE unit result error: Pump calibration cycle error. Pump calibration	Calibration error	Check whether the calibrator has been used up. Recalibrate for 3 times. If the error remains, contact the R&D engineer.
10070001PMQ5	IISE unit result error: Pump calibration cycle error. Calibration value saving failed	Software read/write error	Execute the command for 3 times. If the error remains, contact the R&D engineer.

10070001SEA5	ISE unit result error: Serum cycle error. Air in calibrant A	Calibrator A bottle empty; tube not connected; pump A not working; tube blocked, broken or twisted; fibrin and salt in the tube; air bubble detector error; waste pump error	Wrong electrode installation. Check the pressing plate spring and the sealing to ensure all the electrodes and the O-ring are in the right place. Wash the module by using <CLEN > program. Remove the module and then wash it. Reinstall the sensor. Replace air bubble detection sensor; replace the waste pump; replace the calibrator A and recalibrate; reconnect or replace the tube; check the connection of the motor; replace the pump box; replace the motor; replace the tube.
10070001SEF5	ISE unit result error: Serum cycle error. No flow	Calibrator A and B bottle empty; wrong electrode installation	Replace the calibrator A and B, then recalibrate; check the installation of the electrodes.
10070001SES5	ISE unit result error: Serum cycle error. Air in sample	Insufficient sample volume	Rerun after refilling.

10070001SIA5	ISE unit result error: SIP cycle error. Air in calibrant A	Calibrator A bottle empty; tube not connected; pump A not working; tube blocked, broken or twisted; fibrin and salt in the tube; air bubble detector error; waste pump error	Wrong electrode installation. Check the pressing plate spring and the sealing to ensure all the electrodes and the O-ring are in the right place. Wash the module by using <CLEN > program. Remove the module and then wash it. Reinstall the sensor. Replace air bubble detection sensor; replace the waste pump; replace the calibrator A and recalibrate; reconnect or replace the tube; check the connection of the motor; replace the pump box; replace the motor; replace the tube.
10070001SIF5	ISE unit result error: SIP cycle error. No flow	Calibrator A and B bottle empty; wrong electrode installation	Replace the calibrator A and B, then recalibrate; check the installation of the electrodes.

10070001URA5	ISE unit result error: Urine cycle error. Air in calibrant A	Calibrator A bottle empty; tube not connected; pump A not working; tube blocked, broken or twisted; fibrin and salt in the tube; air bubble detector error; waste pump error	Wrong electrode installation. Check the pressing plate spring and the sealing to ensure all the electrodes and the O-ring are in the right place. Wash the module by using <CLEN > program. Remove the module and then wash it. Reinstall the sensor. Replace air bubble detection sensor; replace the waste pump; replace the calibrator A and recalibrate; reconnect or replace the tube; check the connection of the motor; replace the pump box; replace the motor; replace the tube.
10070001URB5	ISE unit result error: Urine cycle error. Air in calibrant B	Calibrator B bottle empty; tube not connected; pump A not working; tube blocked, broken or twisted; fibrin and salt in the tube; air bubble detector error; waste pump error	Wrong electrode installation. Check the pressing plate spring and the sealing to ensure all the electrodes and the O-ring are in the right place. Wash the module by using <CLEN > program. Remove the module and then wash it. Reinstall the sensor. Replace air bubble detection sensor; replace the waste pump; replace the calibrator B and recalibrate; reconnect or replace the tube; check the connection of the motor; replace the pump box; replace the motor; replace the tube.

10070001URF5	ISE unit result error: Urine cycle error. No flow	Calibrator A and B bottle empty; wrong electrode installation	Replace the calibrator A and B, then recalibrate; check the installation of the electrodes.
10070001URS5	ISE unit result error: Urine cycle error. Air in sample	Insufficient sample volume	Rerun after refilling.
100700020025	ISE unit result error: Na electrode voltage overflow (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700020045	ISE unit result error: K electrode voltage overflow (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700020065	ISE unit result error: K, Na electrodes voltage overflow (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700020085	ISE unit result error: Cl electrode voltage overflow (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
1007000200A5	ISE unit result error: Cl, Na electrodes voltage overflow (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.

1007000200C5	ISE unit result error: Cl, K electrodes voltage overflow (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
1007000200E5	ISE unit result error: Cl, K, Na electrodes voltage overflow (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700030025	ISE unit result error: Na electrode voltage overflow (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700030045	ISE unit result error: K electrode voltage overflow (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700030065	ISE unit result error: K, Na electrodes voltage overflow (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700030085	ISE unit result error: Cl electrode voltage overflow (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.

1007000300A5	ISE unit result error: Cl, Na electrodes voltage overflow (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
1007000300C5	ISE unit result error: Cl, K electrodes voltage overflow (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
1007000300E5	ISE unit result error: Cl, K, Na electrodes voltage overflow (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700040025	ISE unit result error: Na electrode voltage noise (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700040045	ISE unit result error: K electrode voltage noise (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700040065	ISE unit result error: K, Na electrodes voltage noise (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.

100700040085	ISE unit result error: Cl electrode voltage noise (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
1007000400A5	ISE unit result error: Cl, Na electrodes voltage noise (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
1007000400C5	ISE unit result error: Cl, K electrodes voltage noise (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
1007000400E5	ISE unit result error: Cl, K, Na electrodes voltage noise (Cal B/Sample)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700050025	ISE unit result error: Na electrode voltage noise (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700050045	ISE unit result error: K electrode voltage noise (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
100700050065	ISE unit result error: K, Na electrodes voltage noise (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.

100700050085	ISE unit result error: Cl electrode voltage noise (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
1007000500A5	ISE unit result error: Cl, Na electrodes voltage noise (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
1007000500C5	ISE unit result error: Cl, K electrodes voltage noise (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.
1007000500E5	ISE unit result error: Cl, K, Na electrodes voltage noise (Cal A in calib mode, Cal B in urine mode)	Electrodes performance degrading. Replace the electrodes and or calibrator A	Run test after replacing problematic electrodes; Check the calibrator A and recalibrate; there might be drift, if it is a new electrode. Rerun after 15 minutes.

100700060025	ISE unit result error: Na electrode slope drift	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B. If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	Rerun after replacing problematic sensors.
		reference electrode damaged;	reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding 37℃;	rerun after replacing the Na electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.
100700060045	ISE unit result error: K electrode slope drift	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	Rerun after replacing problematic sensors.
		reference electrode damaged;	reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the K electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.

100700060065	ISE unit result error: K, Na electrodes slope drift	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the Cl electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.
100700060085	ISE unit result error: Cl electrode slope drift	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	Reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the Cl electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.

1007000600A5	ISE unit result error: Cl, Na electrodes slope drift	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	Reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the Cl and Na electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.
1007000600C5	ISE unit result error: Cl, K electrodes slope drift	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	Reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the Cl and K electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.

1007000600E5	ISE unit result error: Cl, K, Na electrodes slope drift	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	Reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the Cl, K, Na electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.
100700070025	ISE unit result error: Na electrode out of slope range	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	Reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the Na electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.

100700070045	ISE unit result error: K electrode out of slope range	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	Reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the K electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.
100700070065	ISE unit result error: K, Na electrodes out of slope range	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	Reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the K, Na electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.

100700070085	ISE unit result error: Cl electrode out of slope range	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	Reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the Cl electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.
1007000700A5	ISE unit result error: Cl, Na electrodes out of slope range	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B;If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	Reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the Cl and Na electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.

1007000700C5	ISE unit result error: Cl, K electrodes out of slope range	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	Reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the Cl and K electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.
1007000700E5	ISE unit result error: Cl, K, Na electrodes out of slope range	Wrong electrode installation;	
		calibrator invalidated;	Reinstall the sensor;
		Electrodes performance degrading.	Rerun after replacing the calibrator B; If the result is still abnormal,, rerun after replacing calibrator A;
		air bubble in the electrode;	rerun after replacing problematic sensors.
		reference electrode damaged;	Reinstall and recalibrate, after removing the bubble in the electrode;
		electrodes interact with each other;	rerun after replacing the reference electrode;
		module or fluid path temperature exceeding ℃;	rerun after replacing the Cl, K, Na electrode;
		Something wrong with the sample	monitor the temperature. If the ambient temperature is too high, change the location of the system.

100701250005	ISE unit result error: Instruction sending failed	Serial port cable between ISE module and the main board not connected or serial port cable error	Check the connection between the ISE module and the main board. Check whether the serial port cable is wrong.
100701260005	ISE unit result error: Main unit does not receive response from ISE unit	Serial port cable between ISE module and the main board not connected or serial port cable error	Check the connection between the ISE module and the main board. Check whether the serial port cable is wrong.
100701270005	ISE unit result error: Main unit does not receive results from ISE unit	Serial port cable between ISE module and the main board not connected or serial port cable error	Check the connection between the ISE module and the main board. Check whether the serial port cable is wrong.

9.4.7 Other Units Failures

Error Code	Level	Error Message	Reason	Corrective Measure
A1401	11	Undefined	The automatically generated error code not in the edited range.	Upgrade the operating software or contact the service personnel.

10 Calculation Methods

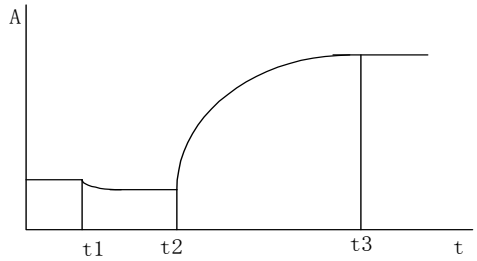
10.1 Reaction Type

The system provides three reaction types for measurement: Endpoint, Fixed-time and Kinetic.

10.1.1 Endpoint

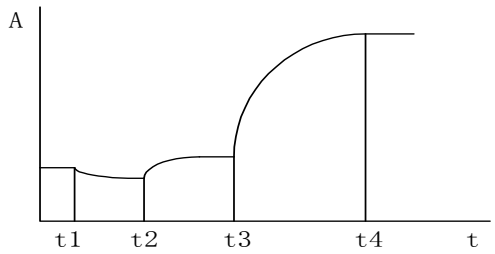
The endpoint or, more correctly, equilibrium method, is most ideal. The reaction reaches equilibrium after a period of time. Since the equilibrium constant is very large, it can be considered that all substrates (analytes) have changed into products, and absorbance of the reaction liquid does not change any more. The absorbance change is directly proportional to the analytes concentration.

Figure 10-1 Single-reagent Endpoint Reaction Curve



As shown in Figure 10-1, t_1 is the time when the reagent is added, and t_2 is the time when the sample is added. The reaction starts when they are mixed. At t_3 the reaction reaches equilibrium and the absorbance reading is taken. The reaction period is t_2 to t_3.

Figure 10-2 Double-reagent Endpoint Reaction Curve



As shown in Figure 10-2 , t_1 is the time when the first reagent is added, and t_2 is the time when the sample is added, incubation starts when they are mixed. t_3 is the time when the second reagent is added, then the reaction starts when they are mixed. At t_4 the reaction reaches equilibrium and the absorbance reading is taken. t_2 to t_3 is the incubation period and t_3 to t_4 is the reaction period.

The endpoint reaction is largely insensitive to minor changes in such condition changes as amount of enzyme, pH and temperature, provided the changes are not significant enough to affect the reaction time.

10.1.2 Fixed-Time

For the fixed-time reaction method (namely, first-order kinetic method or initial rate method), the reaction velocity (v), within a specific period, is directly proportional to the substrate concentration [S], namely, v=k[S]. As the substrate is consumed continuously, the reaction velocity becomes smaller and smaller, and so does the change rate of the absorbance. It takes much time for such a reaction to reach equilibrium. Theoretically, the absorbance reading can be taken at any time. The reaction can, however, become steady only after a delay because it is complicated at the beginning and there are miscellaneous reactions due to the complex serum compositions. For any first order reaction, the substrate concentration [S] at a given time after the start of the reaction is given by the following:

$$[S] = [S_0] \times e^{-kt}$$

Where,

$[S_0]$ - initial substrate concentration,

e - base of the natural log,

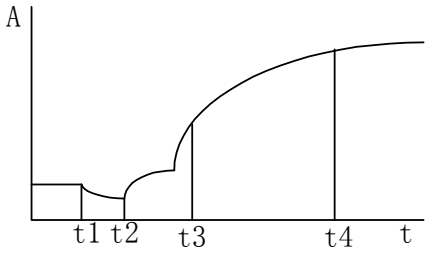
k - rate constant.

The change in substrate concentration Δ[S] over a fixed-time interval, t_1 to t_2, is related to $[S_0]$ by the following equation:

$$[S_0] = \frac{-\Delta[S]}{e^{-kt_1} - e^{-kt_2}}$$

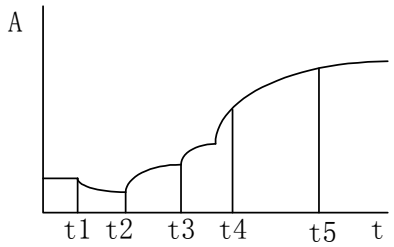
That is, within a fixed time interval, the change in substrate concentration is directly proportional to its initial concentration. This is the general property of first order reactions. Within this interval, absorbance change is directly proportional to the analytes concentration.

Figure 10-3 Single-reagent Fixed-time Reaction Curve



As shown in Figure 10-3, t_1 is the time when the reagent is added and t_2 is the time when the sample is added. The reaction starts when they are mixed. From t_3 the reaction becomes steady and t_4 is the time to stop monitoring the reaction. t_2 to t_3 is the lag period, and the absorbance readings are respectively taken at t_3 and t_4.

Figure 10-4 Double-reagent Fixed-time Reaction Curve



As shown inFigure 10-4 t_1 is the time when the first reagent is added, and t_2 is the time when the sample is added, and then the mixture absorbance reading is taken after they are mixed. t_3 is the time when the second reagent is added, then the reaction starts when they are mixed. At t_4 the reaction reaches equilibrium, and t_5 is the time to stop monitoring the reaction. t_2 to t_3 is the incubation period, and t_3 to t_4 is the delay period. The absorbance readings are respectively taken at t_4 and t_5.

The fixed-time reaction is demanding more technically than the equilibrium method. Because reaction rate is measured at two different points, all the factors that affect reaction rate, such pH, temperature, and amount of enzyme, must be kept constant from one assay to the next, as must the timing of the two measurements. A reference solution of the substrate must be used for calibration.

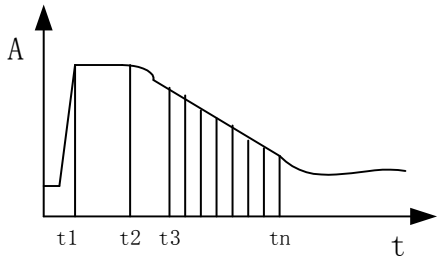
10.1.3 Kinetic

For the kinetic method (namely, zero-order kinetic or continuous-monitoring method), the reaction velocity is not related to the substrate concentration and remains constant in the reaction process. As a result, for a given wavelength, the absorbance of the analytes changes evenly, and the change rate (ΔA/min) is directly proportional to the activity or concentration of the substrate. The kinetic method is usually used to measure enzyme activity.

In fact, it is impossible for the substrate concentration to be high enough, and the reaction will be no longer a zero-order reaction when the substrate is consumed to a certain degree. Therefore, the theory only stands within certain period. In addition, the reaction can become steady only after a certain period of time, because the reaction is

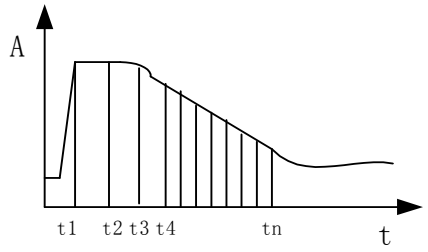
complicated at the beginning and there are miscellaneous reactions due to the complex serum compositions.

Figure 10-5 Single-reagent Kinetic Reaction Curve



As shown in Figure 10-5, t_1 is the time when the reagent is added, t_2 is the time when the sample is added and the reaction starts when they are mixed. From t_3 the reaction becomes steady. t_n is the time to stop monitoring the reaction. t_2 to t_3 is the delay period, and t_3 to t_n is the monitoring period, during which the absorbance readings are taken.

Figure 10-6 Double-reagent Kinetic Reaction Curve

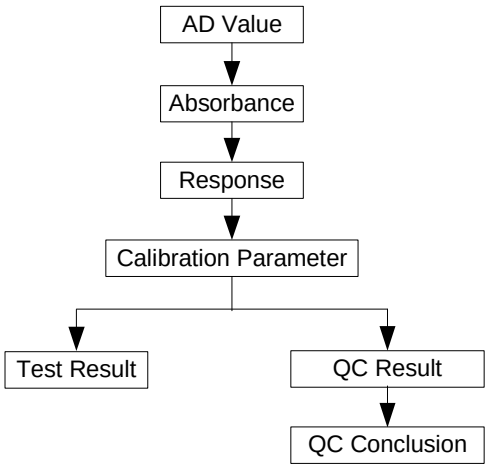


As shown inFigure 10-6, t_1 is the time when the first reagent is added, and t_2 is the time when the sample is added, and then they are mixed. t_3 is the time when the second reagent is added, then the reaction starts when they are mixed. At t_4 the reaction reaches equilibrium, and t_n is the time to stop monitoring the reaction. t_3 to t_4 is the delay period, and t_4 to t_n is the monitoring period, during which the absorbance readings are taken.

10.2 Calculation Process

The system adopts such a measurement and calculation flow as shown in Figure 10-7.

Figure 10-7 Calculation Process



10.2.1 Calculating Absorbance

The system measures the light intensity through photoelectric conversion, linear amplification and AD conversion. For the light intensity signal I_i of Channel i, the AD output D_i is:

$$D_i = K_{pe} \cdot K_a \cdot K_{ad} \cdot I_i$$

Where,

K_{pe} - photoelectric conversion factor

K_a - linear amplification factor

K_{ad} - AD conversion factor

D_i - test data of Channel i

I_i - light intensity of Channel i

So,

$$A_i = \lg \frac{I_{i0}}{I_i} = \lg \frac{D_{i0}}{D_i}$$

Where,

A_i - absorbance of Channel I,

D_{i0} - background AD output,

D_i - AD output after the substrate is added.

In theory, when the lights are off, the AD output of each channel will be zero. In practice, because of the existence of dark current, there is still a background output $D_{ibackground}$, which should be deducted. Then, the complete absorbance formula should be:

$$A_i = \lg \frac{D_{i0} - D_{ibackground}}{D_i - D_{ibackground}}$$

10.2.2 Calculating Response

For the system, the response (R) is defined as the absorbance change before and after the reaction, or the absorbance change rate during the reaction process.

The formula for calculating the response (R) is closely related to the analytical method (kinetic, fixed-time and endpoint), the number of reagents (single or double), and the number of wavelengths (single or double). They are respectively detailed in the following sections.

10.2.2.1 Calculating Response with Endpoint Method

Single-reagent and single-wavelength

$R = R_s - R_{SB}$

R_s and R_{SB} are calculated through $R = A_{t_3} - A_{t_2-1} \times \frac{V}{V+S}$.

Where,

R_s - original response

R_{SB} response of sample blank. If no sample blank is required, $R_{SB} = 0$.

A_{t_3} - absorbance at t_3

A_{t_2-1} - absorbance at previous point of t_2

$\frac{V}{V+S}$ - single-reagent volume calibration factor

Double-reagent and single-wavelength

$R = R_s - R_b$

R_s and R_b are calculated through $R = A_{t_4} - A_{t_3-n} \times \frac{V_1 + S}{V_1 + S + V_2}$.

Where,

R_s - original response

R_b - double-reagent blank response. R_b is the response of the latest reagent blank.

A_{t_4} - absorbance at t_4

A_{t_3-n} - absorbance at $t_3 - n$, $-n$ is the starting value of the reaction time

$\frac{V_1 + S}{V_1 + S + V_2}$ - double-reagent volume calibration factor

Double-wavelength (for both single-reagent and double-reagent)

The calculation method is similar to that for single-wavelength reaction, except that in every measurement period the absorbance is the difference between primary wavelength absorbance and secondary wavelength absorbance.

10.2.2.2 Calculating Response of Fixed-time Reaction

Single-wavelength (for both single-reagent and double-reagent)

$R = R_s - R_b$

R_s and R_b are calculated through $R = \frac{A_{t_m} - A_{t_k}}{t_m - t_k}$.

Where,

R_s - original response

R_b - reagent blank response. R_b will be the response of the latest reagent blank. If no reagent blank has been required, $R_b = 0$

t_l - start time for absorbance reading

t_m - end time for absorbance reading

Double-wavelength (for both single-reagent and double-reagent)

The calculation method is similar to that for single-wavelength reaction, except for every measurement period, the absorbance is the difference between primary wavelength absorbance and secondary wavelength absorbance.

10.2.2.3 Calculating Response of Kinetic Reaction

Single-wavelength (for both single-reagent and double-reagent)

$R = R_s - R_b$

R_s and R_b are calculated through the method of least squares.

Where,

R_s - original response

R_b - reagent blank response. R_b will be the response of the latest reagent blank. If no reagent blank has been required, $R_b = 0$

Formula with the method of least squares:

$$R = \frac{\sum_{i=I}^{M}(T_i - \overline{T}) \cdot (A_i - \overline{A})}{\sum_{i=I}^{M}(T_i - \overline{T})^2}$$

Where, I - high limit of linear range, M - low limit of linear range, A_i - absorbance at i, $\overline{A}$ - average absorbance between I and M, Ti - time at I, $\overline{T}$ - average time between I and M

Double-wavelength (for both single-reagent and double-reagent)

The calculation method is similar to that for single-wavelength reaction, except for every measurement period, the absorbance is the difference between primary wavelength absorbance and secondary wavelength absorbance.

10.2.3 Calculating Calibration Parameters

The system provides two calibration methods: linear calibration and nonlinear calibration. Linear calibration includes one-point linear calibration, two-point linear calibration and multi-point linear calibration. They are mainly used for tests determined by colorimetry. Nonlinear calibration includes Logit-Log 4P, Logit-Log 5P, Exponential 5P, Polynomial 5P, Parabola and Spline. They are mainly used for tests determined by turbidity.

In this section,

- R - calibrator response
- C - calibrator concentration (activity)
- K, R_0, a, b, c - calibration parameters

10.2.3.1 Calculating Linear Calibration Parameters

One-point linear calibration

Calibration formula: $R = aC$

This calibration method adopts only one calibration parameter a, $a = \frac{R}{C}$.

This calibration method requires only one calibrator.

Two-point linear calibration

Calibration formula: $R = aC + b$.

This calibration method adopts two calibration parameters: a and b, where, $a = \frac{R_2 - R_1}{C_2 - C_1}$, $b = R_1 - (\frac{R_2 - R_1}{C_2 - C_1})\ C_1$.

This calibration method requires two calibrators. C_1 and C_2 are respectively the concentrations of calibrator 1 and calibrator 2. R_1 and R_2 are respectively the responses of calibrator 1 and calibrator 2.

Multi-point linear calibration

Calibration formula: $R = aC + b$.

This calibration method adopts two calibration parameters: a and b.

This calibration method requires n (n≥3) calibrators. C_i is the concentration of calibrator i. R_i is the response of calibrator i. a and b can be obtained through the method of least squares.

$$a = \frac{\sum_{i=1}^{n} C_i R_i - (\sum_{i=1}^{n} C_i)(\sum_{i=1}^{n} R_i)/n}{\sum_{i=1}^{n} C_i{}^2 - (\sum_{i=1}^{n} C_i)^2/n}$$

$$b = (\sum_{i=1}^{n} R_i)/n - [\frac{\sum_{i=1}^{n} C_i R_i - (\sum_{i=1}^{n} C_i)(\sum_{i=1}^{n} R_i)/n}{\sum_{i=1}^{n} C_i{}^2 - (\sum_{i=1}^{n} C_i)^2/n}](\sum_{i=1}^{n} C_i)/n$$

10.2.3.2 Calculating Nonlinear Calibration Parameters

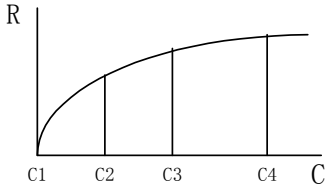
Logistic-Log 4P

Calibration formula: $R = R_0 + K\frac{1}{1+\exp[-(a+b\ln C)]}$

This calibration method adopts four parameters: R_0, K, a and b.

This calibration method requires at least four calibrators. The concentration (or activity) of calibrator 1 is 0, and the corresponding R is equal to R_0.This calibration method is applied to the calibration curve that the response becomes smaller and smaller with the concentration increase. SeeFigure 10-8

Figure 10-8 Logit-Log 4P calibration curve



Logistic-Log 5P

Calibration formula: $R = R_0 + K\frac{1}{1+\exp[-(a+b\ln C+cC)]}$

This calibration method adopts five parameters: R_0, K, a, b and c.

This calibration method requires at least five calibrators. The concentration (or activity) of calibrator 1 is 0, and the corresponding R is equal to R_0.The applications of the

calibration method are the same with that of Logit-Log 4P, but this method has a higher fitting.

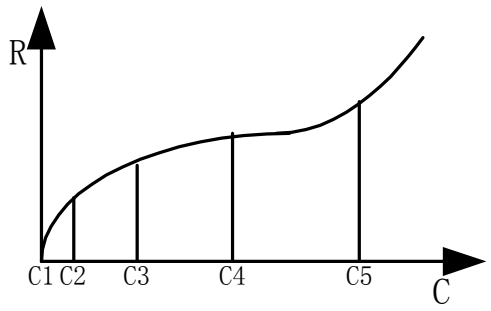
Exponential 5P

Calibration formula: $R = R_0 + K\exp[a\ln C + b(\ln C)^2 + c(\ln C)^3]$

This calibration method adopts five parameters: R_0, K, a, b and c.

This calibration method requires at least five calibrators. The concentration (or activity) of calibrator 1 is 0, and the corresponding R is equal to $R_{0\,0.}$This calibration method is applied to the calibration curve that the response increases sharply when the concentration reaches a specific value. SeeFigure 10-9.

Figure 10-9 Exponential 5p calibration curve



Polynomial 5P

Calibration formula: $\ln C = a + b(\frac{R-R_0}{100}) + c(\frac{R-R_0}{100})^2 + d(\frac{R-R_0}{100})^3$

This calibration method adopts five parameters: R_0, a, b, c and d.

This calibration method requires at least five calibrators. The concentration (or activity) of calibrator 1 is 0, and the corresponding R is equal to R_0.

Parabola

Calibration formula: $R = aC^2 + bC + c$

This calibration method adopts three parameters: a, b and c.

This calibration method requires at least three calibrators. The calibration parameters can be calculated through the method of polynomial least squares.

Spline

Calibration formula: $R = R_{0i} + a_i(C - C_i) + b_i(C - C_i)^2 + c_i(C - C_i)^3$

This calibration method requires 2 to 6 calibrators. The number of calibrators is set to be n, so the calibration method has 4(n-1) parameters in total: R_{0i}, a_i, b_i and c_i.

10.2.4 Calculating Concentration

10.2.4.1 Calculating Concentration of Linearly Calibrated Sample/control

One-point linear calibration

$$C = \frac{R}{a}$$

Where,

a - calibration parameter

Two-point linear calibration

$$C = \frac{R - b}{a}$$

Where,

a, b - calibration parameters

Multi-point linear calibration

$$C = \frac{R - b}{a}$$

Where,

a, b - calibration parameters

10.2.4.2 Calculating Concentration of Nonlinearly Calibrated Sample/control

Logistic-Log 4P

$$C = EXP\left(\frac{-a - \ln\left(\frac{K}{R - R_0} - 1\right)}{b}\right)$$

Where,

R_0, K, a, b - calibration parameters

Logistic-Log 5P

The positive real root is obtained with the dichotomy method.

Exponential5P

The positive real root is obtained with the dichotomy method.

Polynomial5P

$$C = \exp(a + b(\frac{R - R_0}{100}) + c(\frac{R - R_0}{100})^2 + d(\frac{R - R_0}{100})^3)$$

Where,

R_0, a, b, c, d - calibration parameters

Parabola

The positive real root of the following linear quadratic equation is obtained: $aC^2 + bC + c - R = 0$

Spline

Spline defines several calculation sections based on the responses of calibration concentrations. Each section differs in specific parameters. Therefore, the section to which the current response belongs should be confirmed before Spline calculation. The parameters of relevant section shall be used to obtain a positive real root with the dichotomy method.

10.2.5 QC Rule

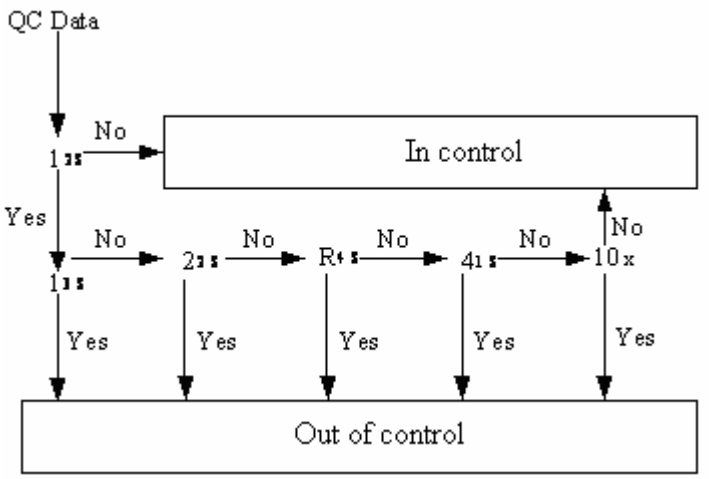
10.2.5.1 Westgard Multi-rule

Westgard multi-rule is shown below.

Symbol	Explanation	QC Conclusion
1_{2S}	One control value exceeds ±2 standard deviations.	Warning
1_{3S}	One control value exceeds ±3 standard deviations.	Out-of-control (random error, systematic error)
2_{2S}	Two consecutive control values for one level exceed ±2 standard deviations.	Out-of-control (systematic error)
R_{4S}	The difference between two consecutive control values exceeds 4 standard deviations.	Out-of-control (random error)
4_{1S}	Four consecutive control values for one level exceed ±1 standard deviation.	Out-of-control (systematic error)
10_X	Ten consecutive control values for one level lie on one side of the mean.	Out-of-control (systematic error)

Westgard multi-rule QC conclusion flow for single control is shown in Figure 10-10.

Figure 10-10 Westgard Multi-rule QC Conclusion Flow



For several controls, the conclusion logic is similar to the above condition, except for multiple continuous QC data, which should be combined simultaneously.

10.2.5.2 Cumulative Sum Check

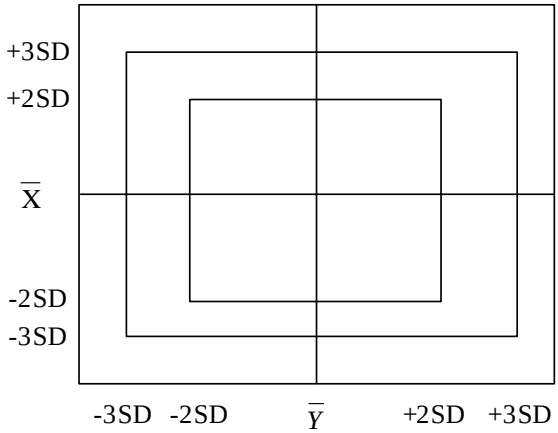
Regarding different requirements to the QC result, cumulative sum check usually adopts three controlling methods, which are mainly used to monitor the systematic error of the testing methods. Where, $\bar{x}$ - average value, SD - standard deviation.

Controlling Methods	Threshold (k)	Limit(h)
CS-(1.0SD: 2.7SD)	$\bar{x}$ ±1.0SD	±2.7SD
CS-(1.0SD: 3.0SD)	$\bar{x}$ ±1.0SD	±3.0SD
CS-(0.5SD: 5.1SD)	$\bar{x}$ ±0.5SD	±5.1SD

10.2.5.3 Twin-plot

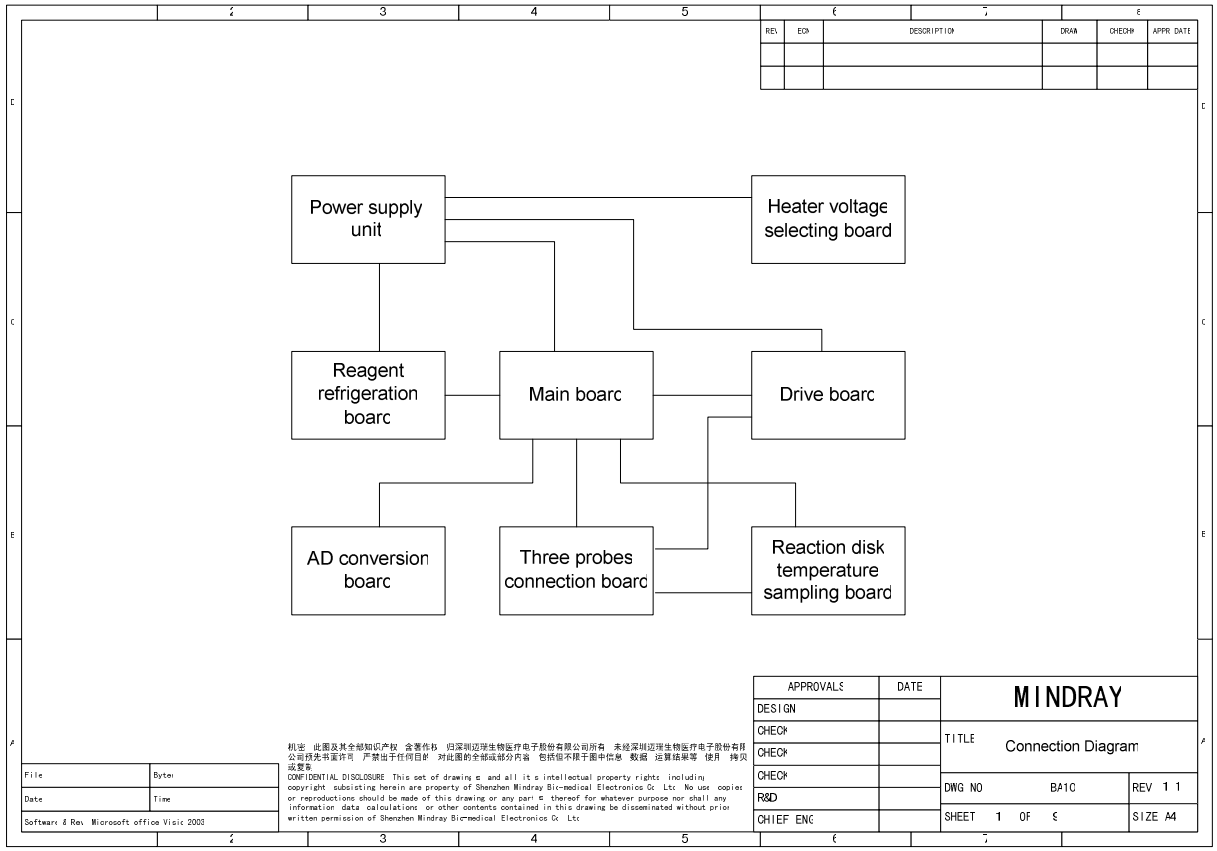
In the system, Twin-plot, which has no detailed rules, is present only as a whole chart to help you make a QC conclusion.

Figure 10-11 Twin-plot



The chart can sensitively indicate the systematic errors and random errors.

Appendix A Connection Diagram



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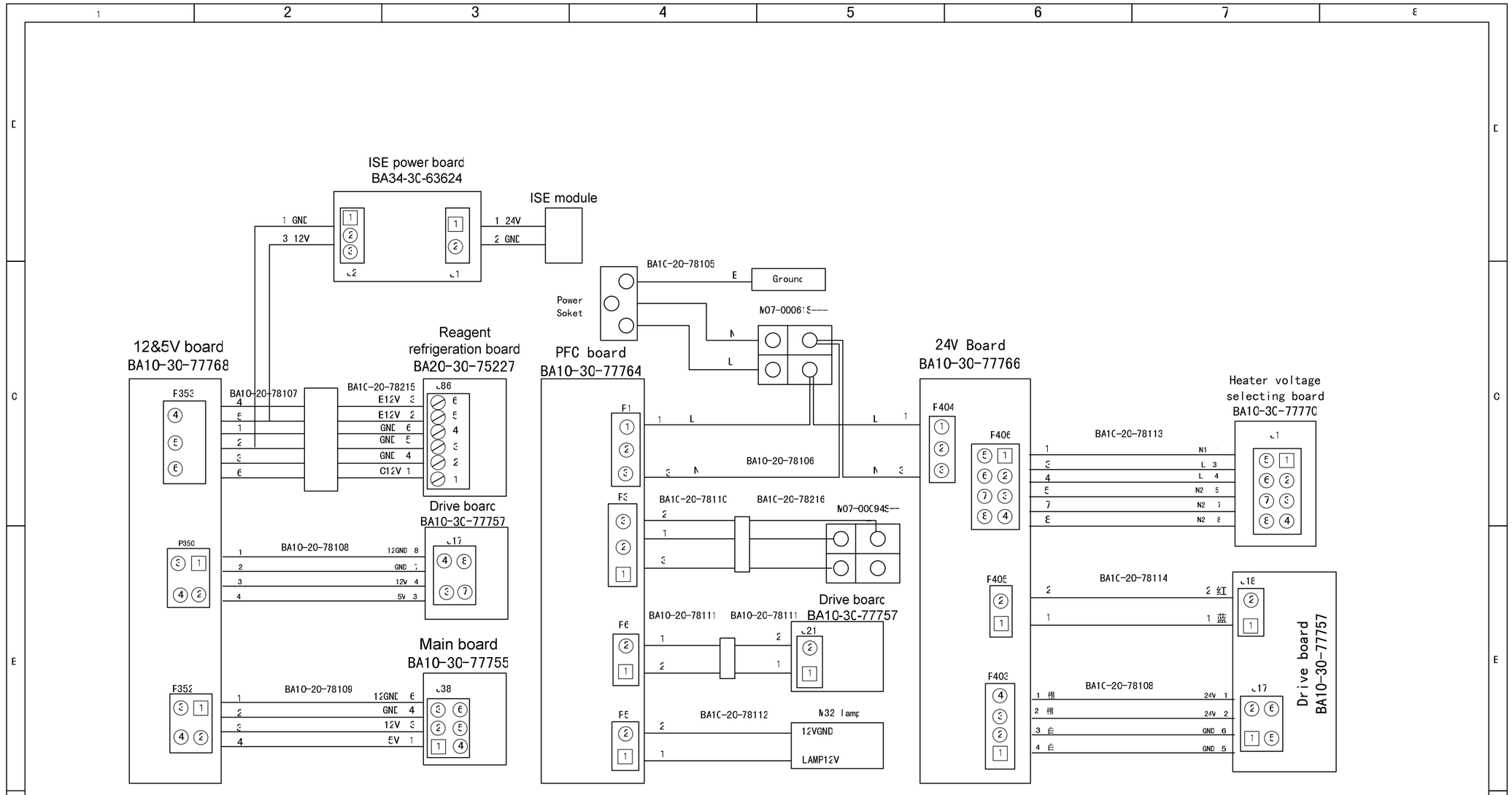

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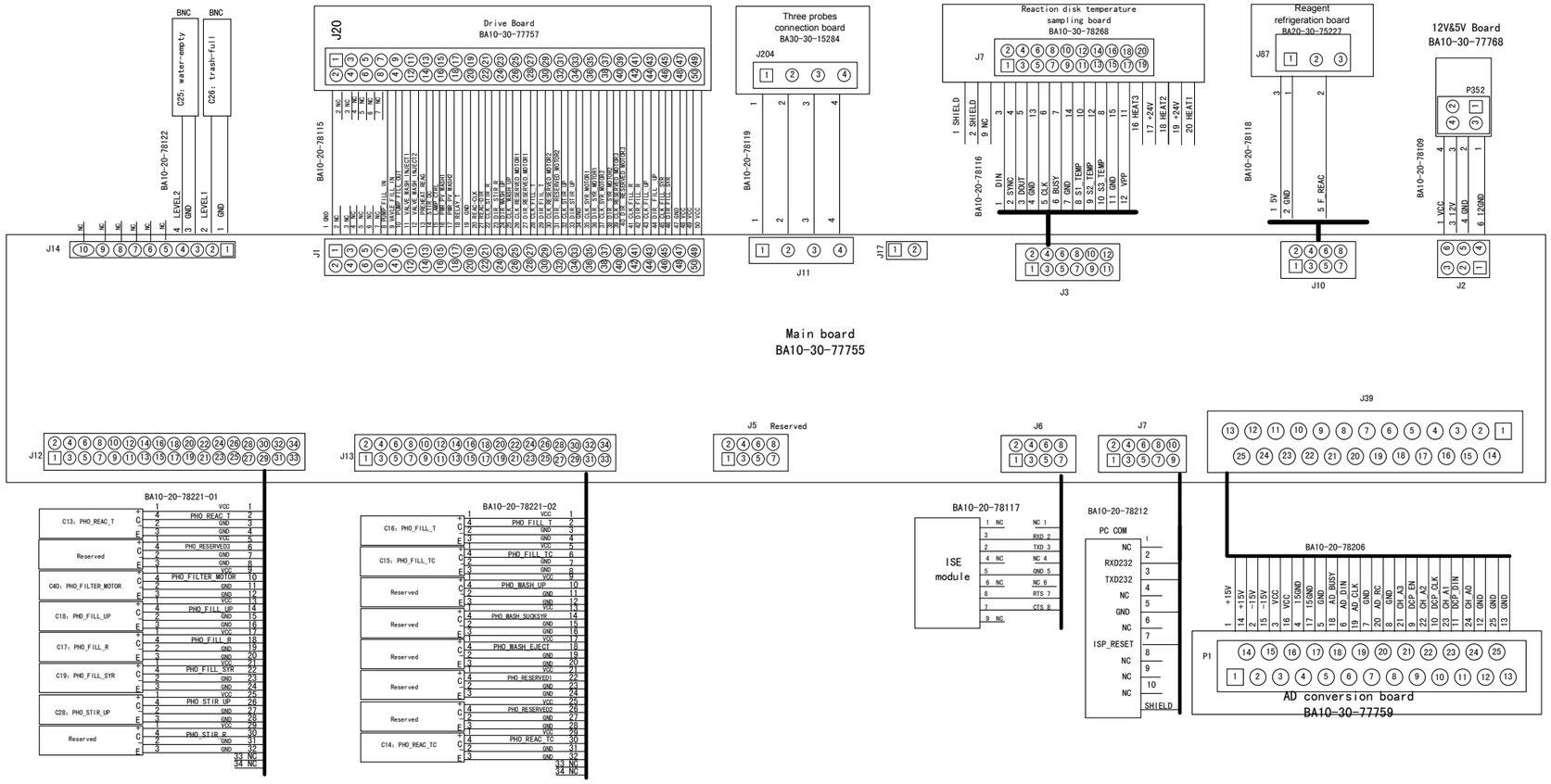
Date:	Time:
Software & Rev Microsoft office Visio 2003	

MINDRAY		
TITLE	Power Supply Unit	
DWG NO	BA10	REV 1.1
SHEET 2 OF 9		SIZE A4



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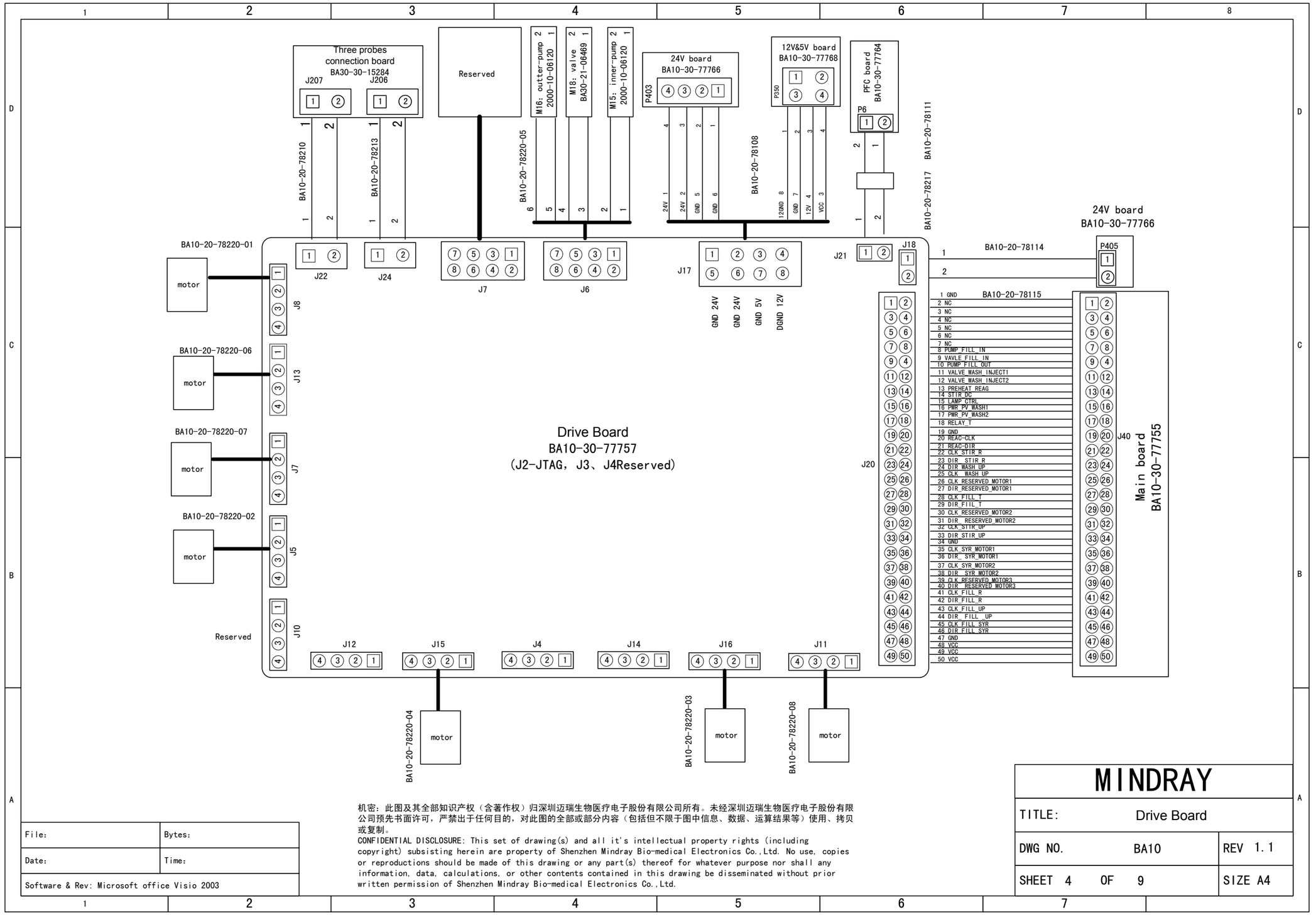
Software & Rev: Microsoft office Visio 2003	

MINDRAY		
TITLE:	Main Board	
DWG NO.	BA10	REV 1.1
SHEET 3 OF 9		SIZE A2



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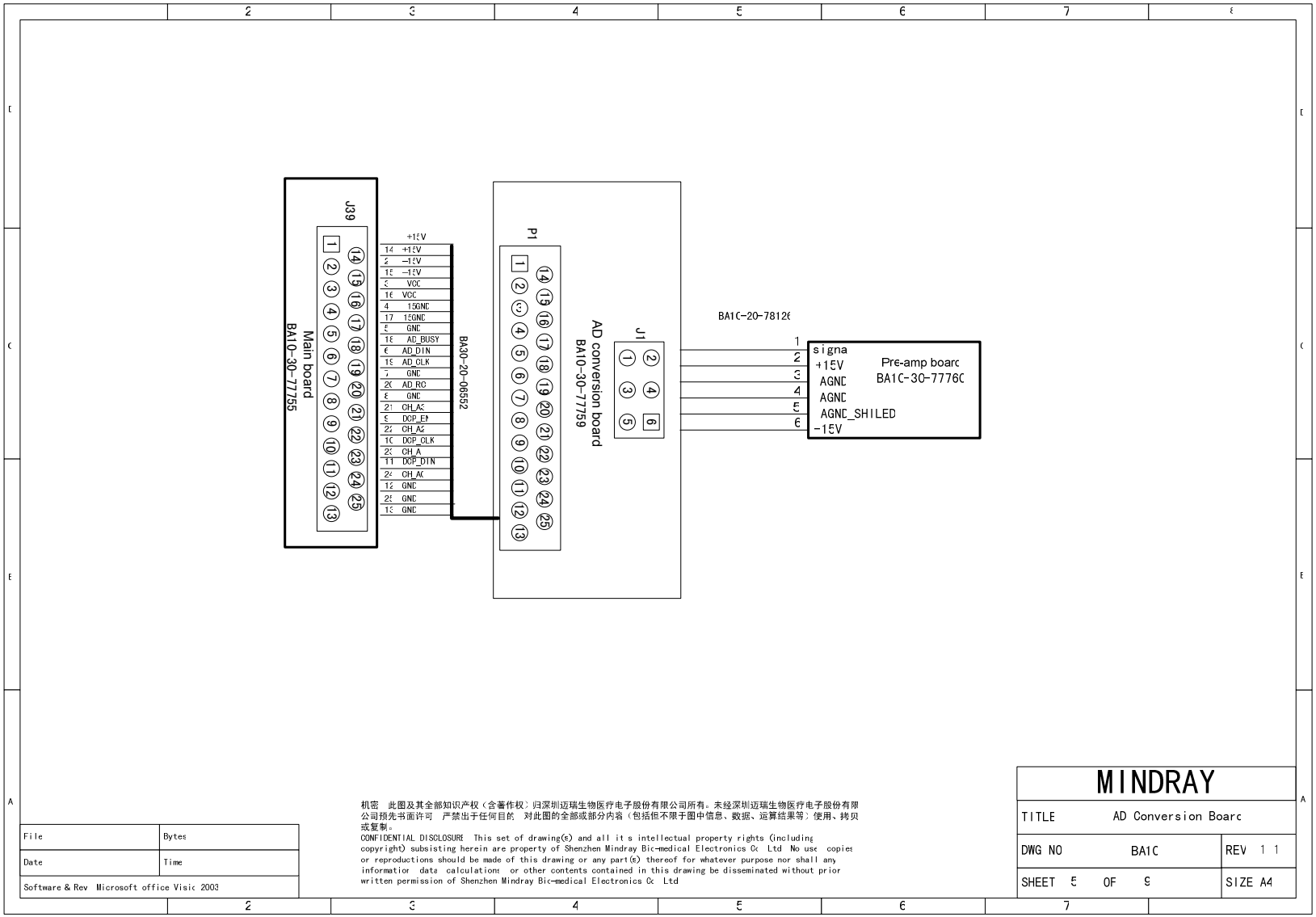
File:	Bytes:
Date:	Time:
Software & Rev: Microsoft office Visio 2003	

MINDRAY		
TITLE:	Drive Board	
DWG NO.	BA10	REV 1.1
SHEET 4 OF 9		SIZE A4



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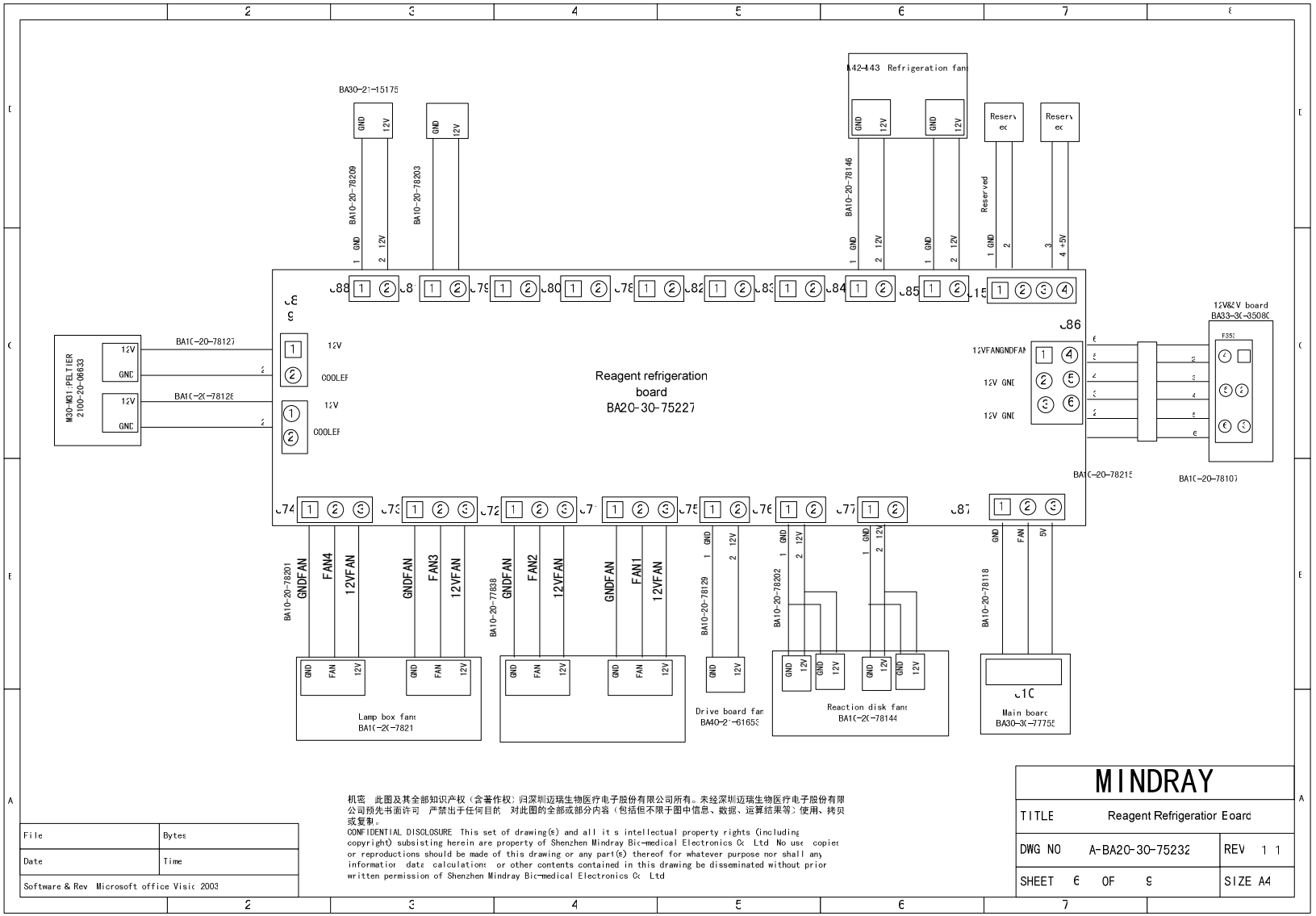
Reagent refrigeration board
BA20-30-75227
M42-M43 Refrigeration fan
BA30-21-15175
BA10-20-78209
BA10-20-78203
BA10-20-78146
Reserved
M30-M31 PELTIER
2100-20-00633
BA10-20-78127
BA10-20-78128
COOLEF
12VFANGNDFAN
12V GNE
12V&5V board
BA33-30-03508
BA10-20-78215
BA10-20-78107
GNDFAN
FAN4
12VFAN
FAN3
FAN2
FAN1
BA10-20-78201
BA10-20-77838
BA10-20-78129
BA10-20-78202
BA10-20-78118
Lamp box fans
BA10-20-78211
Drive board fan
BA40-20-61653
Reaction disk fans
BA10-20-78144
Main board
BA30-30-77755
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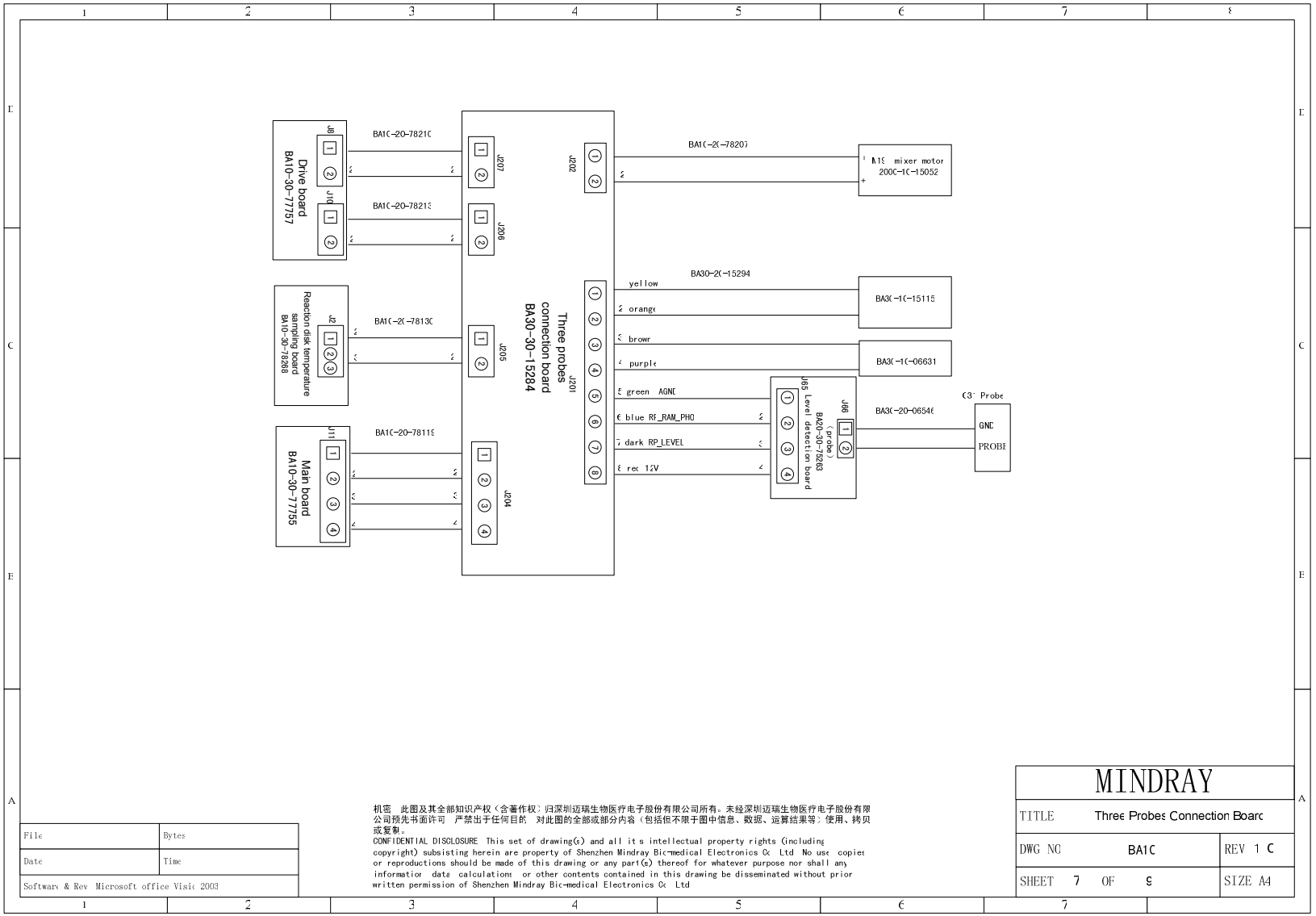
MINDRAY
TITLE Reagent Refrigeration Board
DWG NO A-BA20-30-75232
REV 1.1
SHEET 6 OF 9
SIZE A4
File
Bytes
Date
Time
Software & Rev Microsoft office Visio 2003



File	Bytes
Date	Time
Software & Rev Microsoft office Visio 2003	

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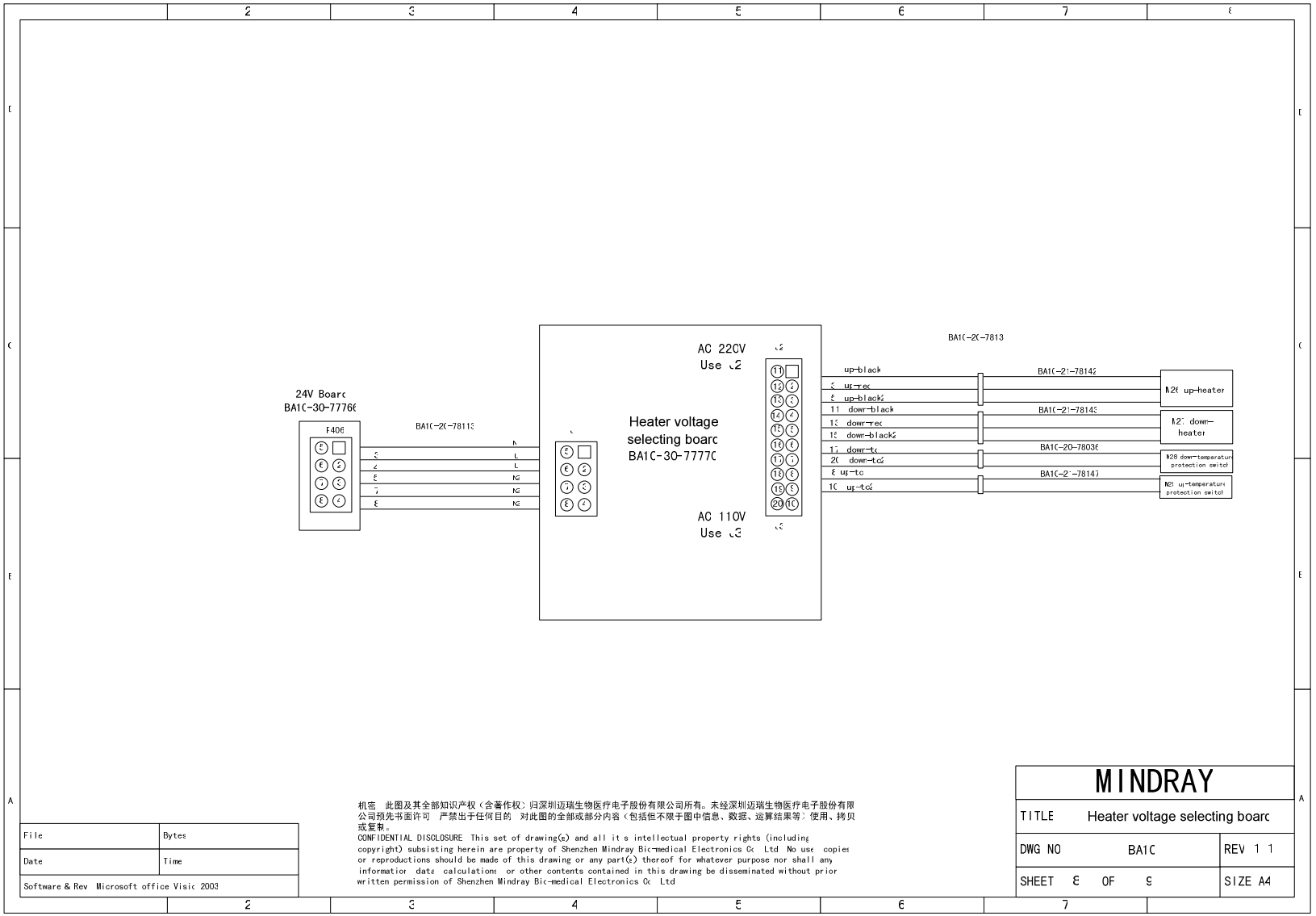
MINDRAY		
TITLE	Three Probes Connection Board	
DWG NO	BA1C	REV 1 C
SHEET 7 OF 9		SIZE A4



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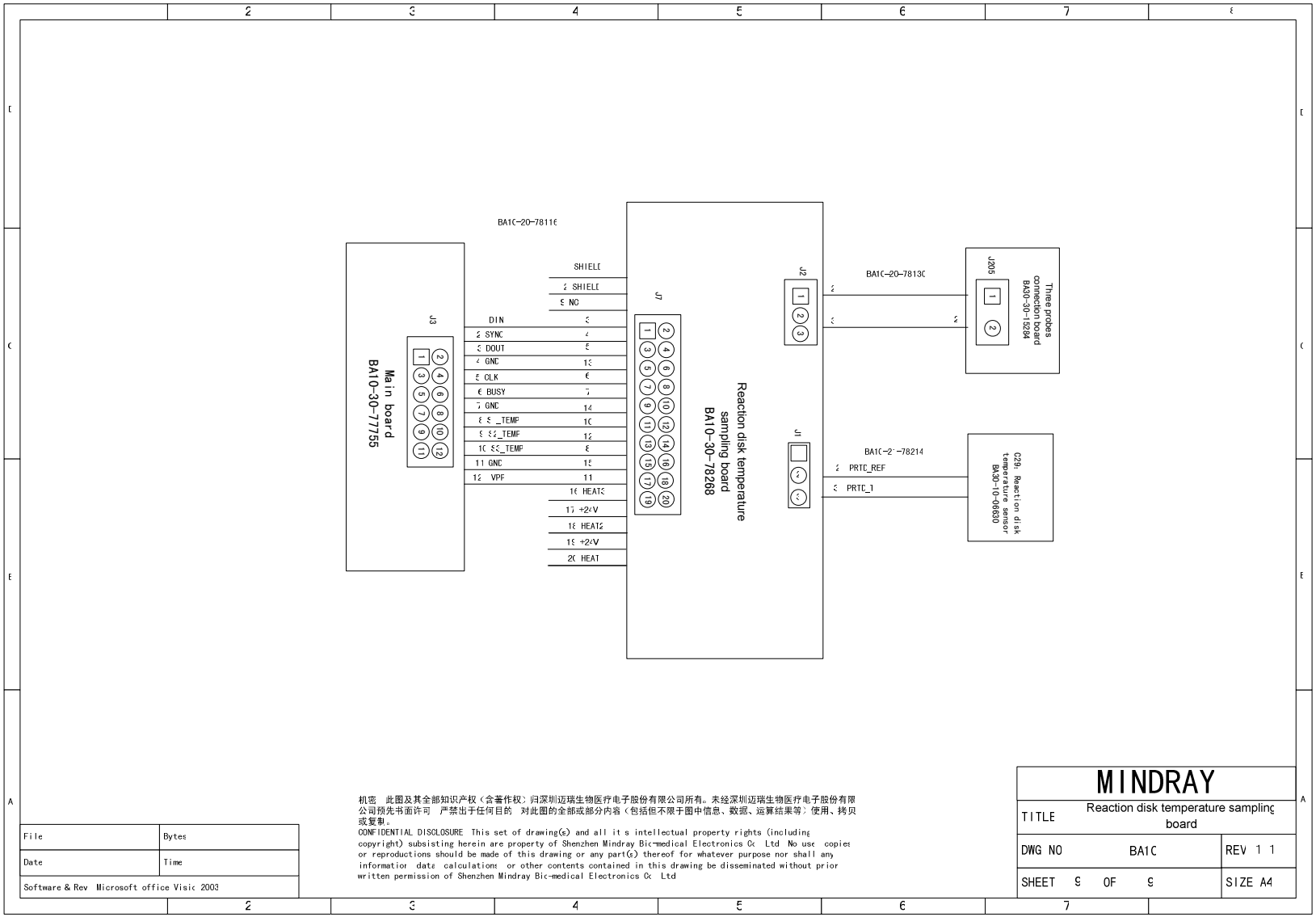

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File	Bytes
Date	Time
Software & Rev Microsoft office Visio 2003	

MINDRAY		
TITLE	Reaction disk temperature sampling board	
DWG NO	BA1C	REV 1.1
SHEET 9 OF 9		SIZE A4